

Biology - 9700

■ 42 Questions

Topics Covered :

- ✓ 6.1 - Structure of nucleic acids and replication of DNA
- ✓ 1.2 - Cells as the basic units of living organisms
- ✓ 6.2 - Protein synthesis
- ✓ 3.2 - Factors that affect enzyme action
- ✓ 1.1 - The microscope in cell studies
- ✓ 7.1 - Structure of transport tissues
- ✓ 4.2 - Movement into and out of cells
- ✓ 11.1 - The immune system
- + 16 more topics...

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Question No 1 - (9700_m25_22_5)

Subsection Topics: (a) : 6.1 - Structure of nucleic acids and replication of DNA, 1.2 - Cells as the basic units of living organisms | (b) : 6.2 - Protein synthesis | (c) : 3.2 - Factors that affect enzyme action

(a) Eukaryotic cells and prokaryotic cells contain DNA.

Complete the passage about DNA in eukaryotic cells and prokaryotic cells, using the most appropriate terms.

In eukaryotic cells, the DNA is located mainly in the chromosomes of the nucleus. Chromosomal DNA is associated with proteins called Two other eukaryotic cell structures that contain DNA are mitochondria and

In prokaryotic cells, for example, the DNA is found in the and is usually circular.

[4]

(b) Fig. 5.1 shows transcription of the first six nucleotides of a gene by the enzyme RNA polymerase. The bases of the first six nucleotides on DNA strand **X** are shown, but the bases on the template DNA strand are **not** shown.

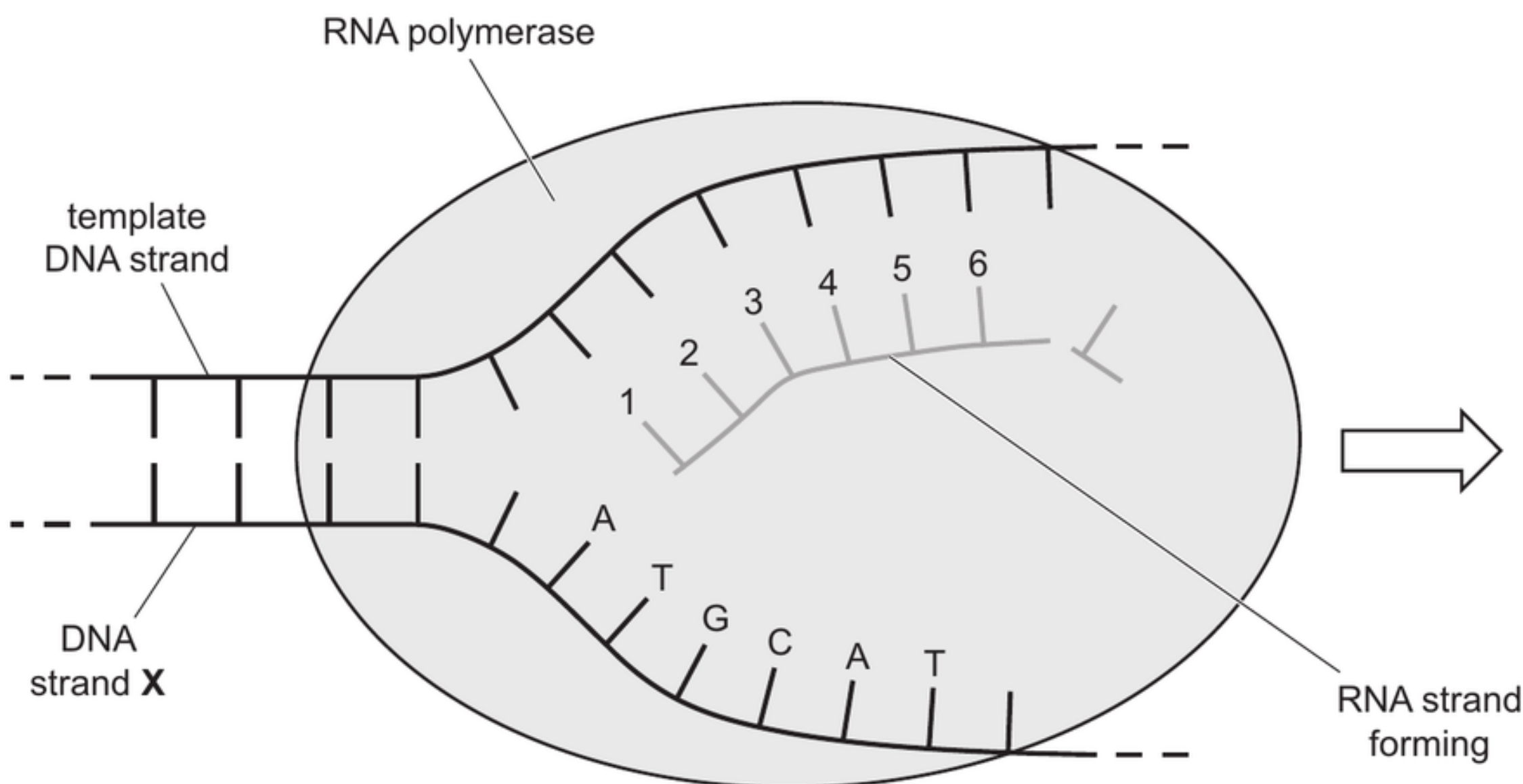


Fig. 5.1

(i) State the term used to describe the non-template DNA strand labelled **X** in Fig. 5.1.

..... [1]

(ii) Name the RNA strand formed during transcription of a eukaryotic gene.

..... [1]

(iii) Complete Table 5.1 to show the letters of the six bases indicated on Fig. 5.1 by the

numbers 1 to 6.

Table 5.1

1	2	3	4	5	6

[1]

- (c) RNA polymerase is composed of several polypeptides that move together and change shape as the enzyme performs its functions.

The death cap mushroom, *Amanita phalloides*, produces a toxin called alpha-amanitin, which binds to RNA polymerase at a site other than the active site. Alpha-amanitin reduces the activity of RNA polymerase.

Use the information provided to suggest how alpha-amanitin reduces the activity of RNA polymerase.

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..... [3]

[Total: 10]

Question No 2 - (9700_m25_22_1)

Subsection Topics: (a) : 1.1 - The microscope in cell studies | (b) : 1.1 - The microscope in cell studies | (c) : 7.1 - Structure of transport tissues | (d) : 4.2 - Movement into and out of cells | (e) : 4.2 - Movement into and out of cells | (f) :

Smilax china is a herbaceous plant.

Fig. 1.1 shows part of a transverse section of a root of *S. china* with root hair cells visible.

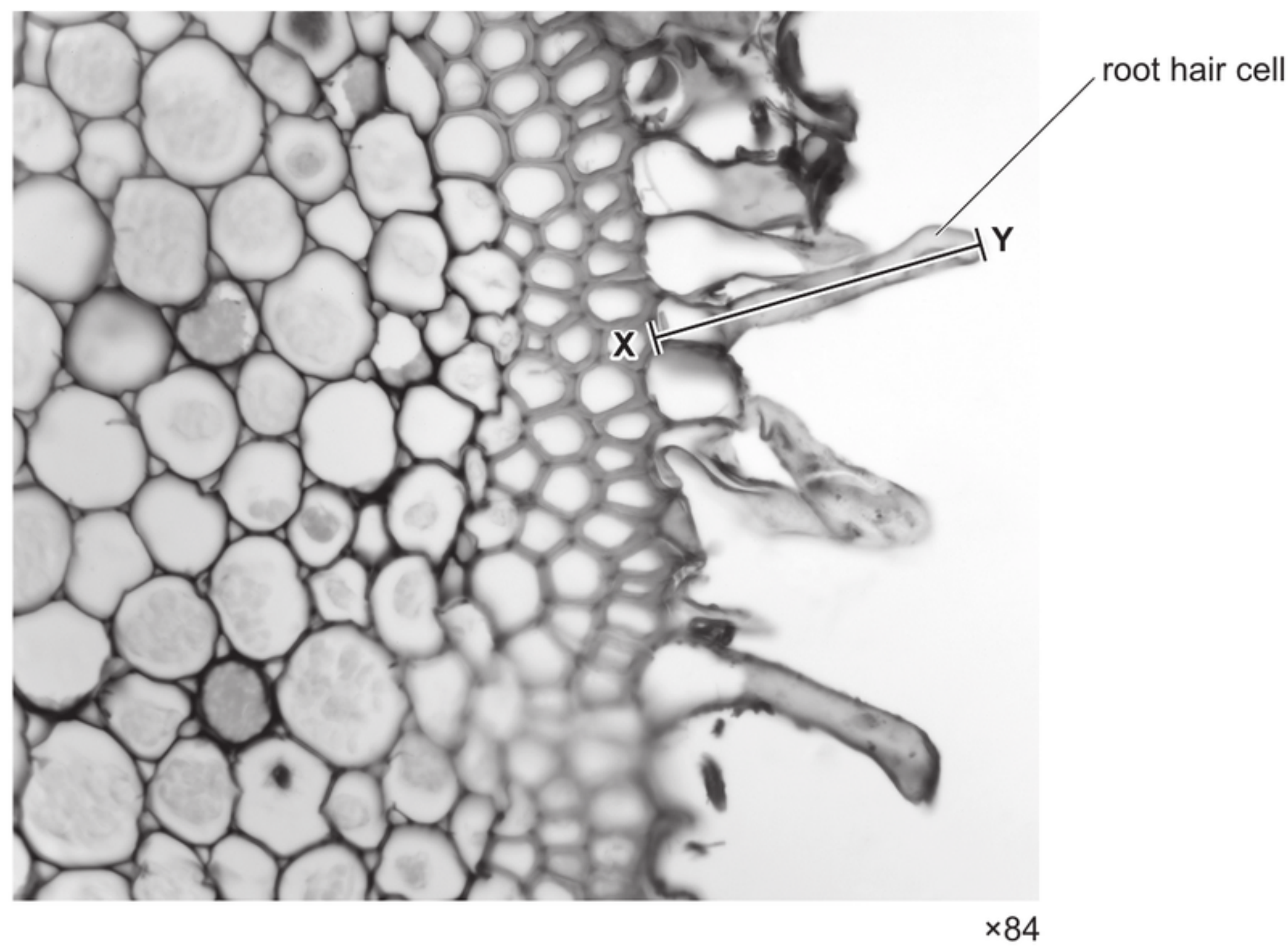


Fig. 1.1

(a) Name the type of microscope that has been used to obtain the image in Fig. 1.1.
..... [1]

(b) Calculate the **actual** length, in micrometres (μm), of the root hair cell labelled in Fig. 1.1. Use the **image** length of the root hair cell along line **X–Y** in your calculation.

actual length = μm [1]

(c) Root hairs are important adaptations of root hair cells for the uptake of water.
Explain **one** way in which root hairs adapt root hair cells for the uptake of water.
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..... [1]

(d) Mineral ions are taken up by root hair cells.

Table 1.1 shows the concentrations of sodium ions (Na^+) and potassium ions (K^+) inside the root hair cells of a plant root and in the soil solution surrounding the root.

Table 1.1

concentration of Na^+ / g dm^{-3}		concentration of K^+ / g dm^{-3}	
root hair cell	soil solution	root hair cell	soil solution
0.35	3.34	5.46	0.16

With reference to Table 1.1:

- suggest the mechanisms involved in the transport of Na^+ and K^+ from the soil solution into the root hair cells
- state the reasons for your suggestions.

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..... [3]

(e) The region between the outer layer of a root and the endodermis is known as the cortex. Table 1.2 shows the water potential of two adjacent cells, **A** and **B**, in the cortex of a root.

Table 1.2

water potential / kPa	
cortex cell A	cortex cell B
–120	–350

With reference to Table 1.2, explain the direction of water movement between cell **A** and cell **B**.

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..... [2]

(f) Some types of soil are made of small negatively charged clay particles that attract and bind to positive ions such as iron ions (Fe^{2+}).

Fe^{2+} that is bound to clay particles **cannot** be absorbed by root hair cells. This reduces the concentration of free Fe^{2+} that is available in soil solution for absorption.

Some plants that grow in soils containing a high proportion of clay particles are able to increase the concentration of free Fe^{2+} in the soil solution for absorption. In these plants, the carbon dioxide released by the respiration of root hair cells reacts with water in the soil solution, which changes the pH of the soil solution. This affects the binding of positively charged ions, such as Fe^{2+} , to clay particles.

Fig. 1.2 shows the results of one investigation into the effect of pH on the concentration of free Fe^{2+} that is available in soil solution for absorption by root hair cells. The soil sample analysed in this investigation was from a soil that contained a high proportion of clay particles.

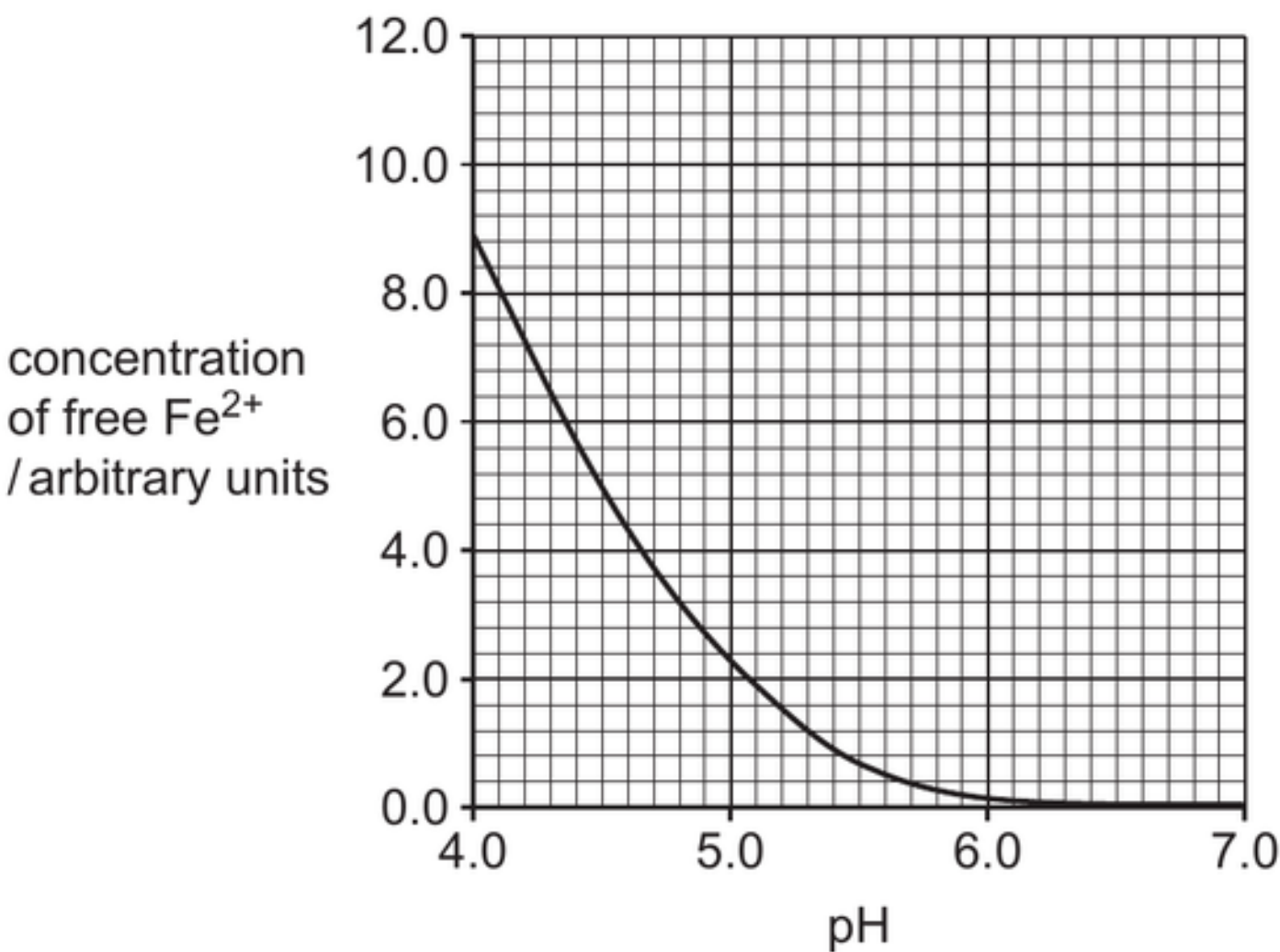


Fig. 1.2

- (i) With reference to Fig. 1.2, suggest **and** explain how the carbon dioxide released by the respiration of root hair cells can increase the concentration of free Fe^{2+} for absorption by root hair cells.

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- (ii) Dissolved Fe^{2+} is transported across the tissues of the root to the xylem.

When the amount of dissolved Fe^{2+} absorbed by root hair cells is greater than the amount that is needed by the plant, not all of the Fe^{2+} that is absorbed is transported to the xylem.

Suggest how the endodermis can reduce the amount of Fe^{2+} reaching the xylem.

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[3]

Question No 3 - (9700_m24_22_6)

Subsection Topics: (a) : 1.1 - The microscope in cell studies | (b) : 11.1 - The immune system | (c) : 6.2 - Protein synthesis, 11.1 - The immune system | (d) : 11.2 - Antibodies and vaccination

Fig. 6.1 is a simplified diagram representing a section through the human immunodeficiency virus (HIV) particle that causes HIV/AIDS. The diagram shows the virus particle about to attach to the cell surface membrane of a T-helper cell at a receptor protein called CD4. A second protein (coreceptor) called CCR5 is also necessary for the virus particle to enter and then infect the T-helper cell.

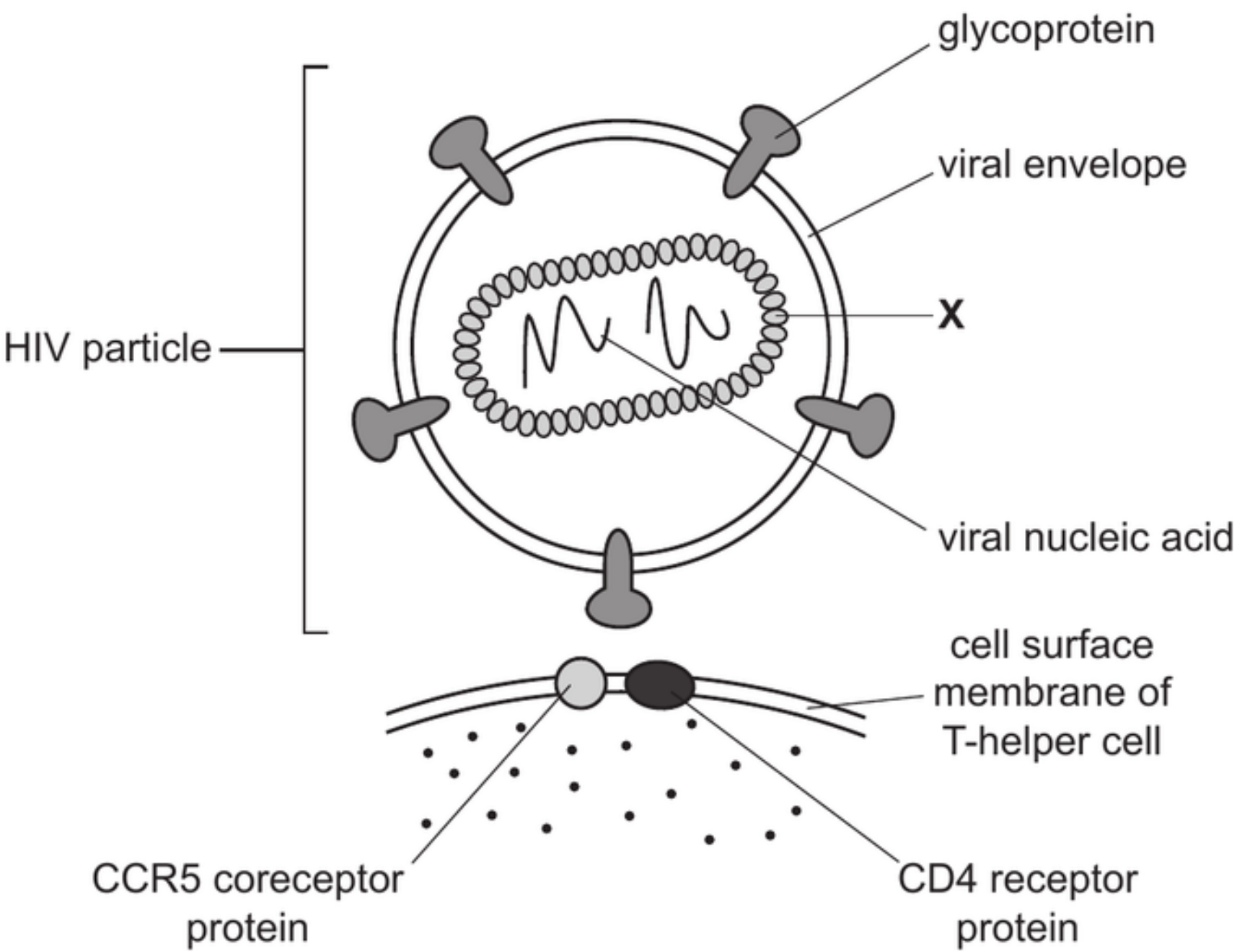


Fig. 6.1

- (a) Identify structure X in Fig. 6.1.

..... [1]
- (b) Explain how the ability of the immune system to resist the damaging effects of a pathogen is affected by destruction of T-helper cells.

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..... [3]

(c) Studies have shown that some individuals did not become infected with HIV even though

- (c) Studies have shown that some individuals did NOT become infected with HIV even though they were repeatedly exposed to the virus. Later discoveries indicated that these individuals had a mutation in the gene for the CCR5 coreceptor protein.

Suggest how mutation of the gene for the CCR5 coreceptor protein provided protection against HIV infection.

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..... [1]

- (d) The use of monoclonal antibodies against the CCR5 coreceptor protein (anti-CCR5) has been shown to be effective in the treatment of HIV infection.

Outline how anti-CCR5 monoclonal antibodies can be synthesised in the laboratory using the hybridoma method.

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..... [3]

Question No 4 - (9700_m24_22_1)

Subsection Topics: (a) : 2.2 - Carbohydrates and lipids, 4.1 - Fluid mosaic membranes | (b) : 4.2 - Movement into and out of cells | (c) : 1.2 - Cells as the basic units of living organisms, 2.3 - Proteins, 3.2 - Factors that affect enzyme action

(a) Fig. 1.1 is a diagram representing part of the phospholipid bilayer of a cell surface membrane.

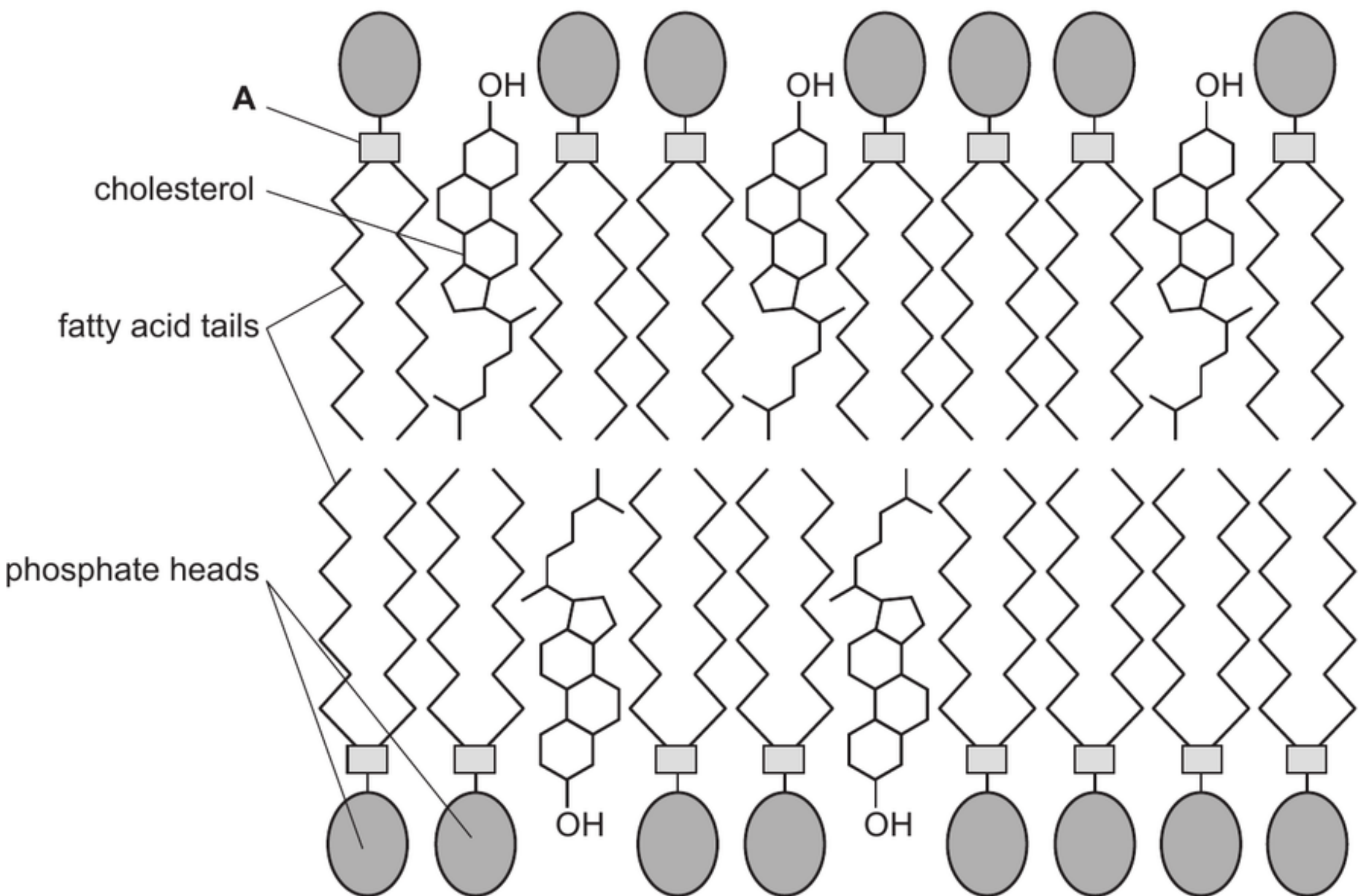


Fig. 1.1

(i) Identify the part of a phospholipid molecule, labelled **A** in Fig. 1.1, that forms bonds with the phosphate heads and with the fatty acid tails.

..... [1]

(ii) Cholesterol is an important lipid component of many cell surface membranes. Fig. 1.2 shows the structure of a cholesterol molecule.

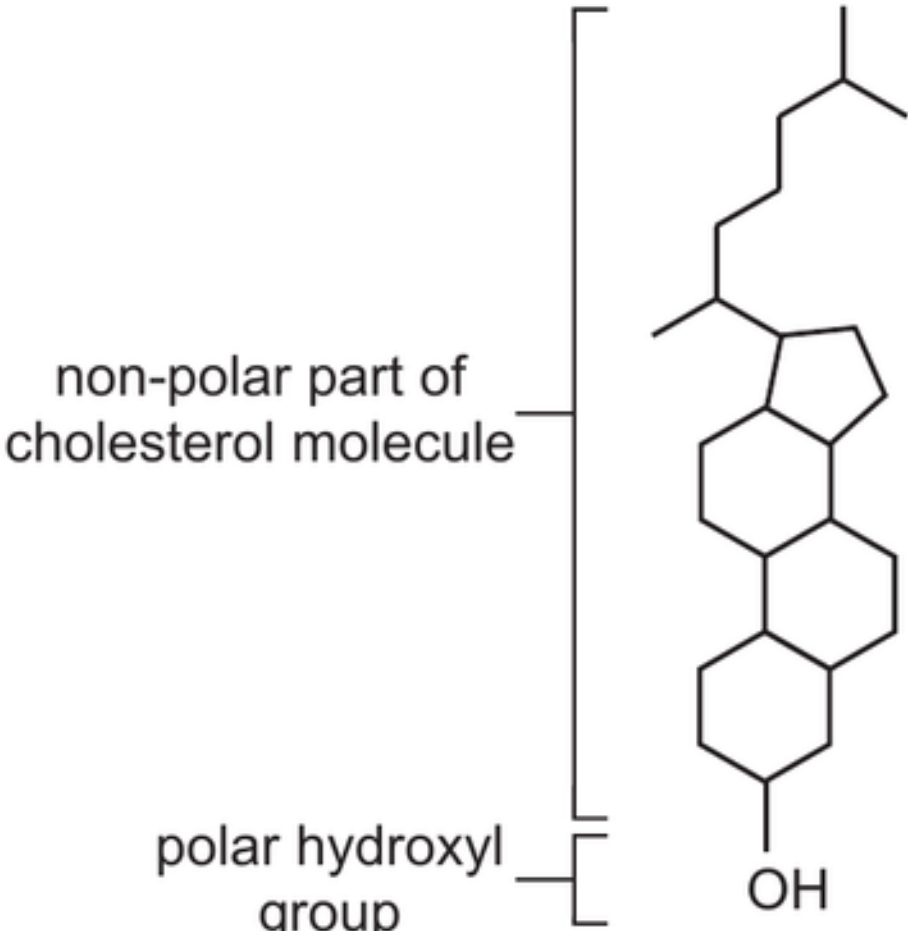


Fig. 1.2

Using the information in Fig. 1.2, explain the orientation (positioning) of cholesterol molecules in the phospholipid bilayer, as shown in Fig. 1.1.

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.....
..... [1]

(iii) State **one** role of cholesterol in phospholipid bilayers.

.....
.....
..... [1]

(b) (i) Explain why sodium ions **cannot** cross phospholipid bilayers by simple diffusion.

.....
.....
..... [1]

(ii) Ions and some molecules move across cell surface membranes by facilitated diffusion and active transport.

Compare facilitated diffusion and active transport by stating **one** way in which they are similar and **two** ways in which facilitated diffusion is different from active transport.

similarity
.....
difference 1
.....
.....
difference 2
.....
.....

[3]

(c) Prostaglandins are small lipids produced in many tissues of the body. One role of prostaglandins is to cause inflammation at the site of an injury or infection. Inflammation is the normal first

response of the immune system to injury or infection.

Cyclooxygenase (COX) is an enzyme that catalyses one of the steps in the reaction pathway for the formation of prostaglandins from phospholipids. The reaction pathway occurs in the smooth endoplasmic reticulum (SER) of cells. Part of the reaction pathway is shown in Fig. 1.3.

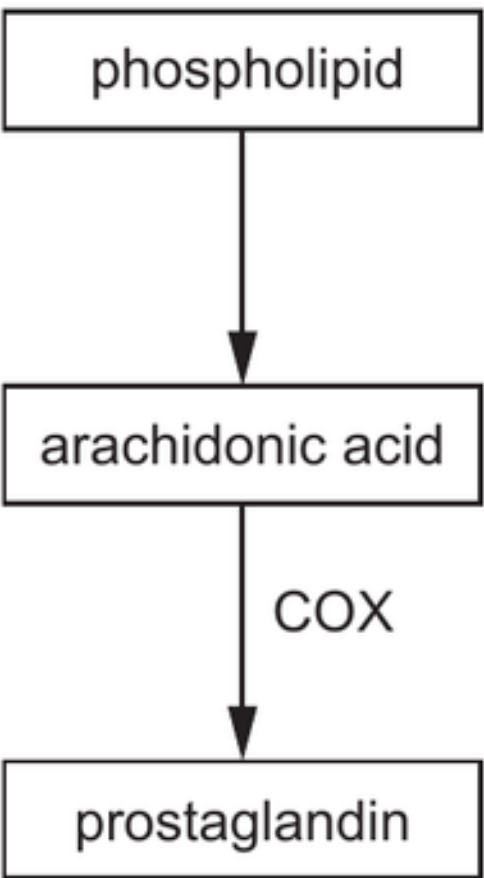


Fig. 1.3

- (i) Suggest an advantage for this reaction pathway occurring in the smooth endoplasmic reticulum of a cell rather than in the cytoplasm.

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.....
..... [1]

- (ii) Sometimes inflammation can have side-effects, such as pain. Aspirin is a drug that can be used to reduce these side-effects.

Aspirin reduces the catalytic activity of the COX enzyme by modifying the R-group of one of the amino acids.

Suggest how modifying the R-group of an amino acid in the COX enzyme can reduce the catalytic activity of the enzyme.

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..... [3]

- (iii) Prostaglandins are examples of cell-signalling molecules.

Outline the process of cell signalling that leads to a response by the cells involved in inflammation.

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..... [2]

Question No 5 - (9700_m24_22_5)

Subsection Topics: (a) : 1.1 - The microscope in cell studies, 10.1 - Infectious diseases | (b) : 1.2 - Cells as the basic units of living organisms

The pathogen that causes cholera is a prokaryote.

(a) Fig. 5.1 shows an electron micrograph of the pathogen that causes cholera.

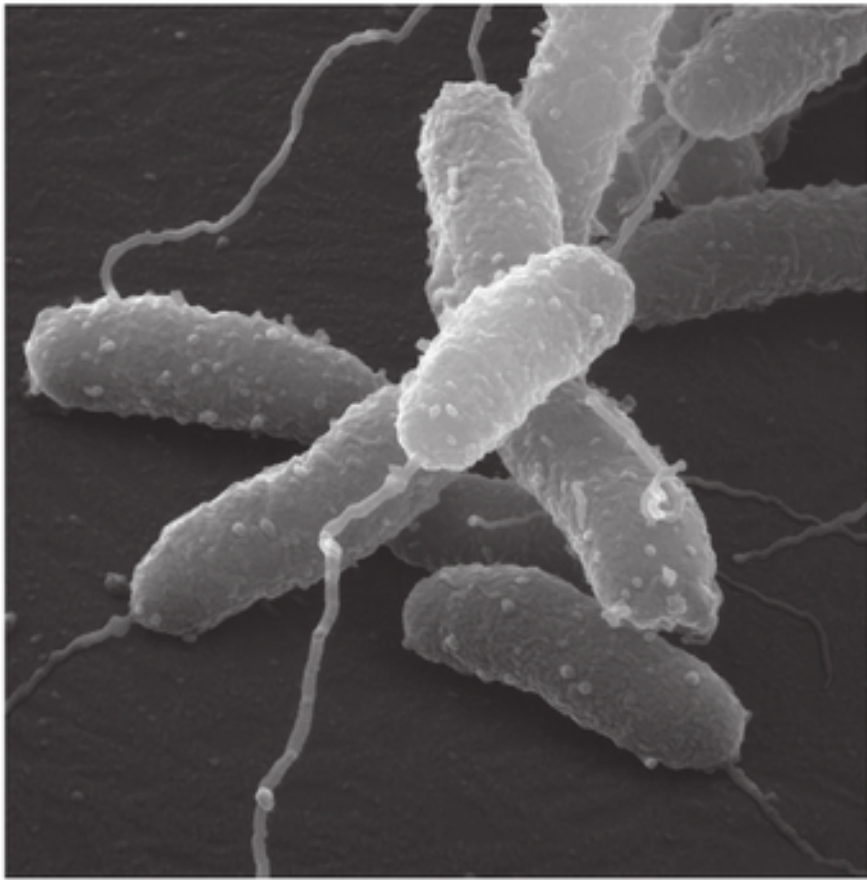


Fig. 5.1

- (i)** Name the type of electron microscope used to produce the image shown in Fig. 5.1.
- [1]
- (ii)** Name the species of prokaryote that causes cholera.
- [1]
- (b)** The passage contains a description of the main features of prokaryotic cells. There is **one** factual error in the passage.

Prokaryotic cells are unicellular and generally between 1µm and 5µm in diameter. Prokaryotes do **not** have organelles surrounded by double membranes. They do have cell surface membranes, 70S ribosomes and a cellulose cell wall. The DNA of a prokaryotic cell is circular and is found free in the cytoplasm rather than enclosed in a nuclear envelope.

Identify **and** correct the factual error in the passage.

.....

..... [1]

Question No 6 - (9700_m24_22_3)

Subsection Topics: (a) : 7.1 - Structure of transport tissues | (b) : 1.2 - Cells as the basic units of living organisms | (c) : 2.2 - Carbohydrates and lipids

(a) Fig. 3.1 is a photomicrograph showing part of a transverse section through the root of an iris, *Iris germanica*. Irises are herbaceous monocotyledons. These plants have the same transport tissues as herbaceous dicotyledons, but the transport tissues are distributed differently. In monocotyledons, the central tissue in the root is parenchyma (packing tissue).

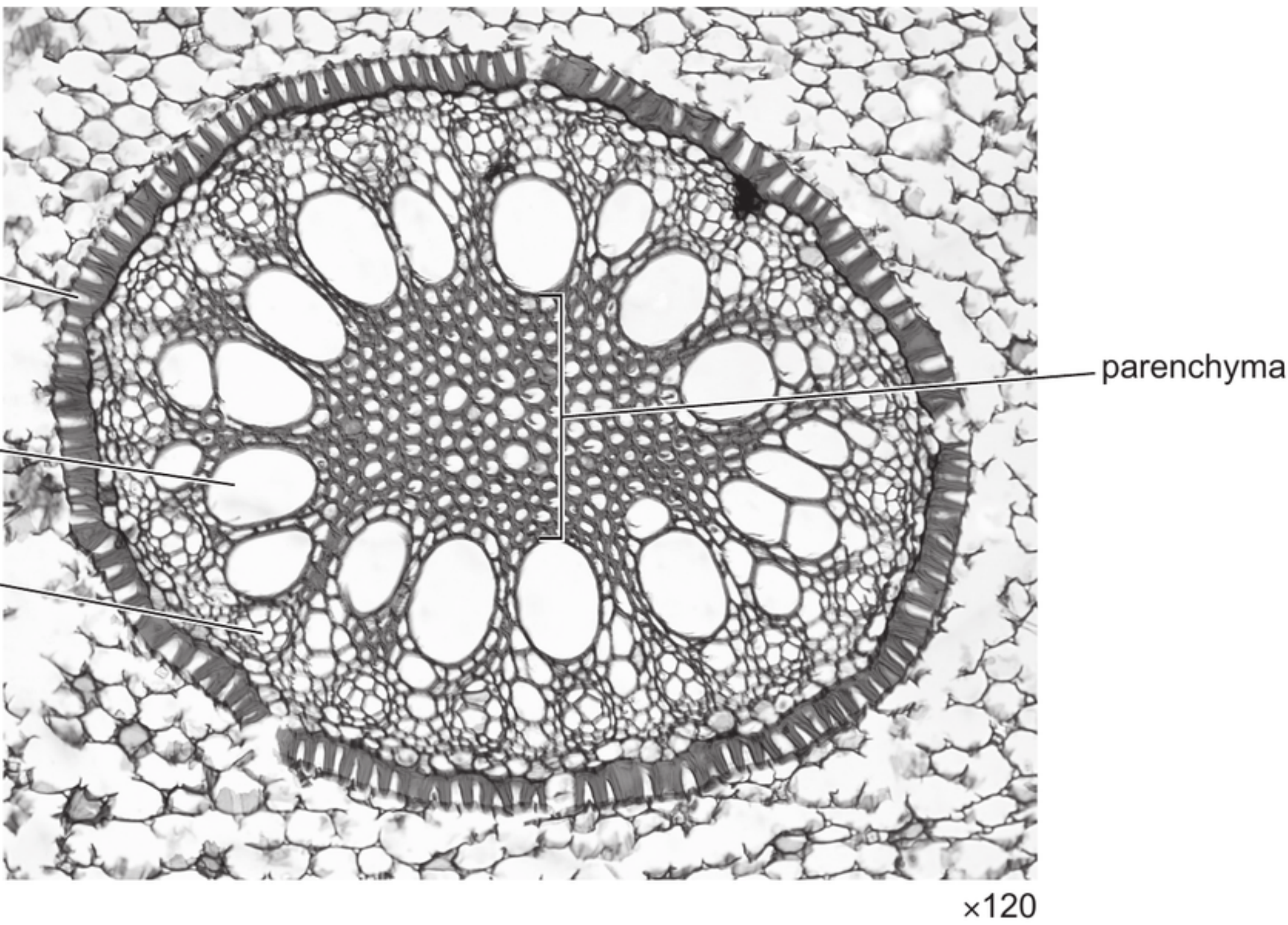
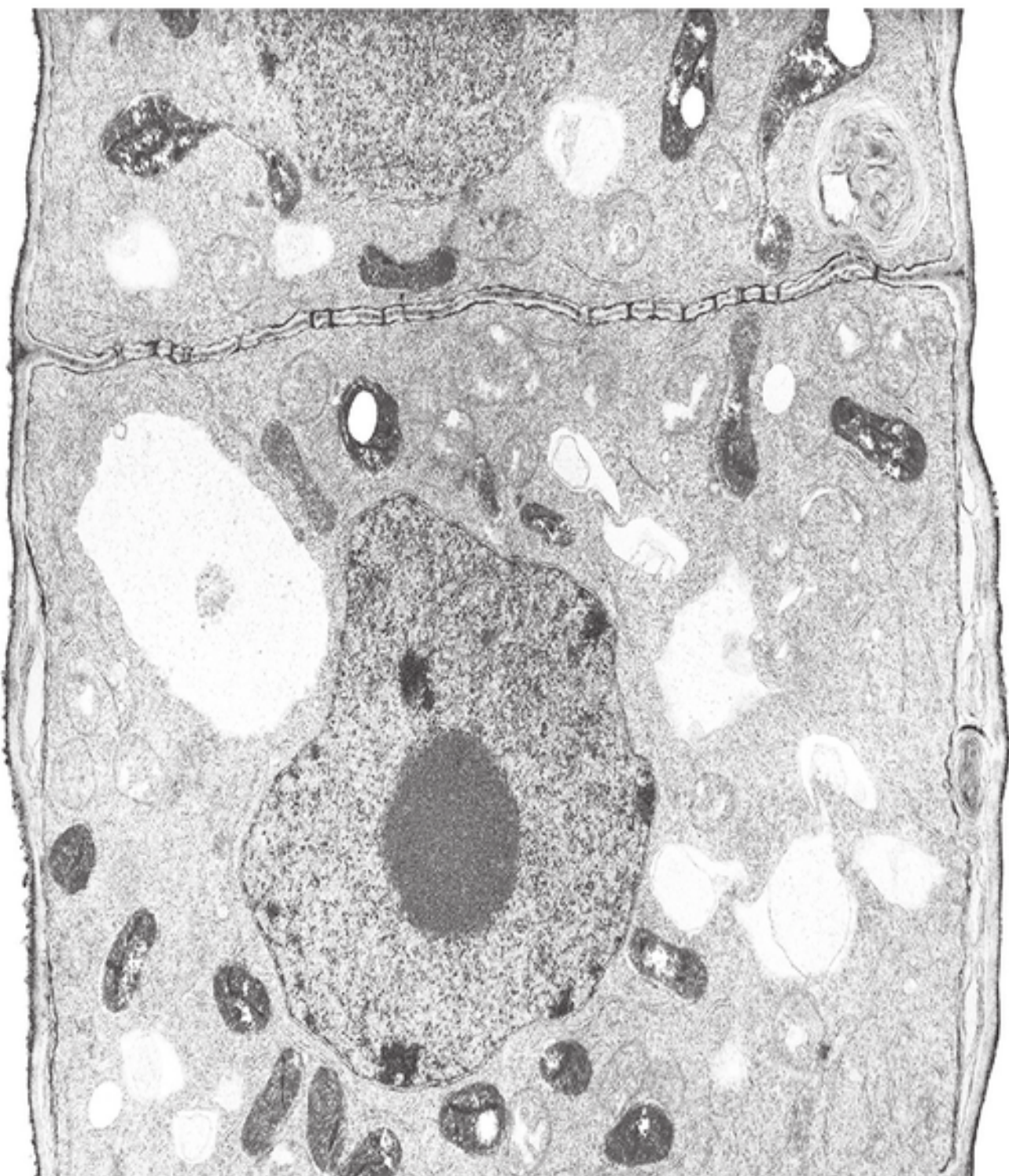


Fig. 3.1

- (i) Cells **R**, **S** and **T** in Fig. 3.1 are found in different tissues.
- Name the tissues in which the cells labelled **R**, **S** and **T** are found.
- tissue in which cell **R** is found
- tissue in which cell **S** is found
- tissue in which cell **T** is found [3]
- (ii) Outline the role of the tissue in which cell **R** is found in Fig. 3.1.
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-
-
- [2]
- (iii) State an example of an organic compound that is translocated in the root of an iris.
- [1]
- (b) The electron micrograph in Fig. 3.2 shows a section through some root cells in an onion, *Allium cepa*.



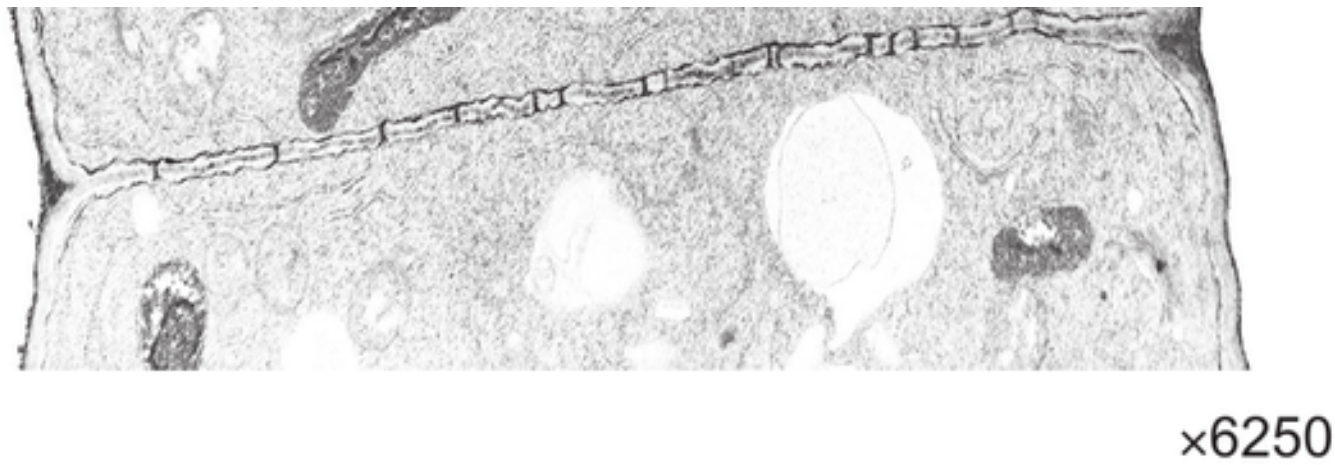


Fig. 3.2

On Fig. 3.2, draw a label line and label it with the letter **P** to identify **one** plasmodesma. [1]

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(c) Table 3.1 contains information about four polysaccharides found in animals or plants.
Complete Table 3.1 by filling in the missing information.

Table 3.1

polysaccharide	monomer	glycosidic bond(s)	function
amylopectin	α -glucose	1,4 and 1,6	energy storage in plants
amylose		1,4	energy storage in plants
cellulose	β -glucose		structural role in plant cell walls
glycogen	α -glucose	1,4 and 1,6	

[3]

Question No 7 - (9700_s24_21_1)

Subsection Topics: (a) : 4.1 - Fluid mosaic membranes | (b) : 1.1 - The microscope in cell studies, 1.2 - Cells as the basic units of living organisms

Fig. 1.1 is a diagram showing part of a cell surface membrane of an animal cell.

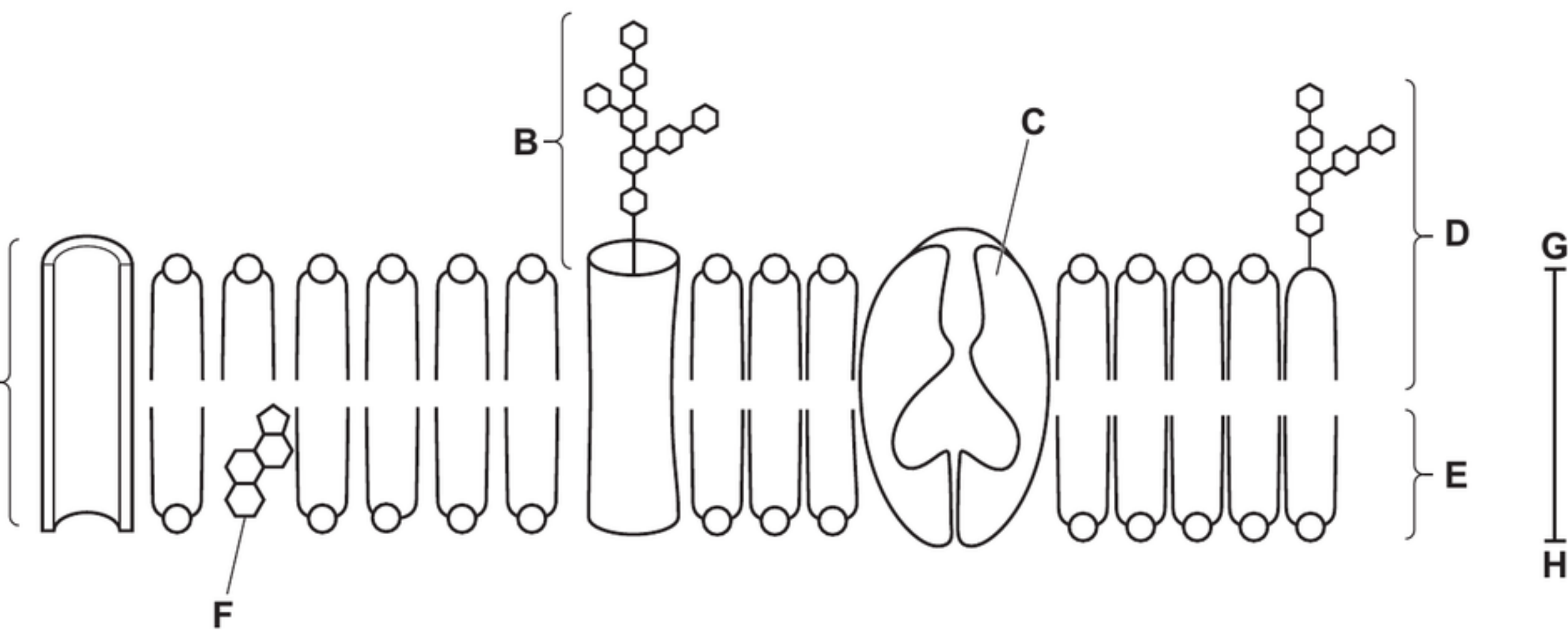


Fig. 1.1

- (a) (i) State the approximate thickness of the membrane as shown by the line **G–H**.
- [1]
- (ii) Complete Table 1.1 to show:
- the names and functions of the components of the cell surface membrane
 - the letters of the labels in Fig. 1.1 that identify each component.

Table 1.1

component	function	letter on Fig. 1.1
channel protein		
phospholipid		
	receptor for cell signalling	
		F

[4]

- (b) Fig. 1.2 is a drawing of a transmission electron micrograph (TEM) of a cell from the palisade mesophyll of a leaf.

The drawing does **not** show all of the organelles visible in a transmission electron micrograph.

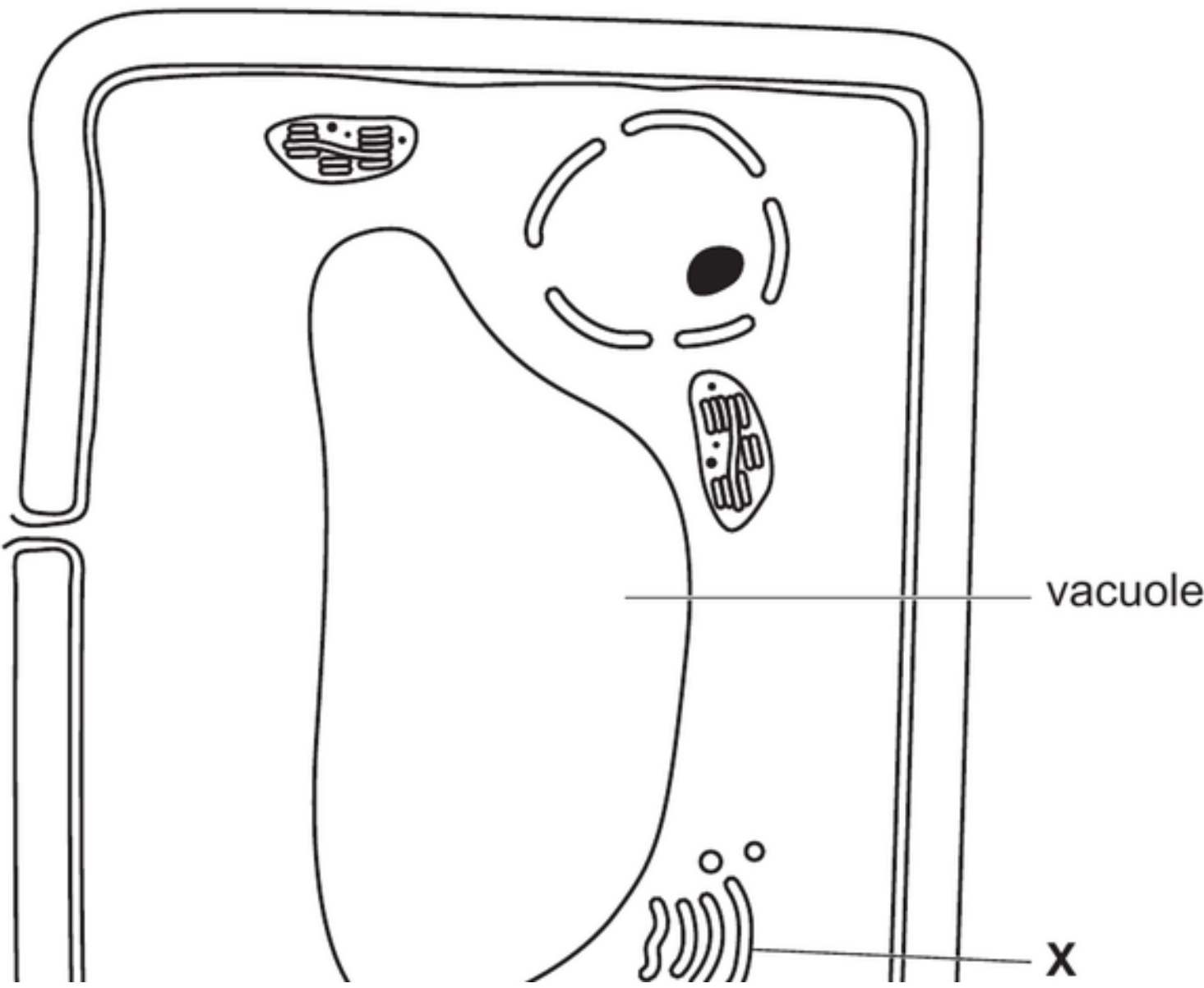




Fig. 1.2

(i) Complete Fig. 1.2 by drawing **and** labelling:

- a mitochondrion
- rough endoplasmic reticulum
- smooth endoplasmic reticulum.

Your drawings should show the detail that can be seen in a transmission electron micrograph. [3]

(ii) Identify the organelle labelled **X** and state **one** function of this organelle.

name

function

.....

[2]

[Total: 10]

Question No 8 - (9700_s24_22_2)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms, 1.1 - The microscope in cell studies | (b) : 4.2 - Movement into and out of cells | (c) : 11.2 - Antibodies and vaccination

Alveolar macrophages are cells of the immune system that remain in the alveolar region of the gas exchange system. The macrophages protect against infection caused by pathogens that have been inhaled.

- (a) Alveolar macrophages have the same cell structures as typical animal cells.
- (i) Complete Table 2.1 to **name** the cell structures that match the functions stated.
- Do **not** use abbreviations.

Table 2.1

cell structure	function
.....	manufactures ribosomal subunits from proteins and ribosomal RNA
.....	synthesises triglycerides and other lipids
pair of	organise microtubules of the cell cytoskeleton

[3]

- (ii) Fig. 2.1 is a diagram of an alveolar macrophage showing:
- some of the cell structures that would be visible using an electron microscope
 - a newly formed phagocytic vacuole (phagosome) containing two cells of *Mycobacterium tuberculosis*.

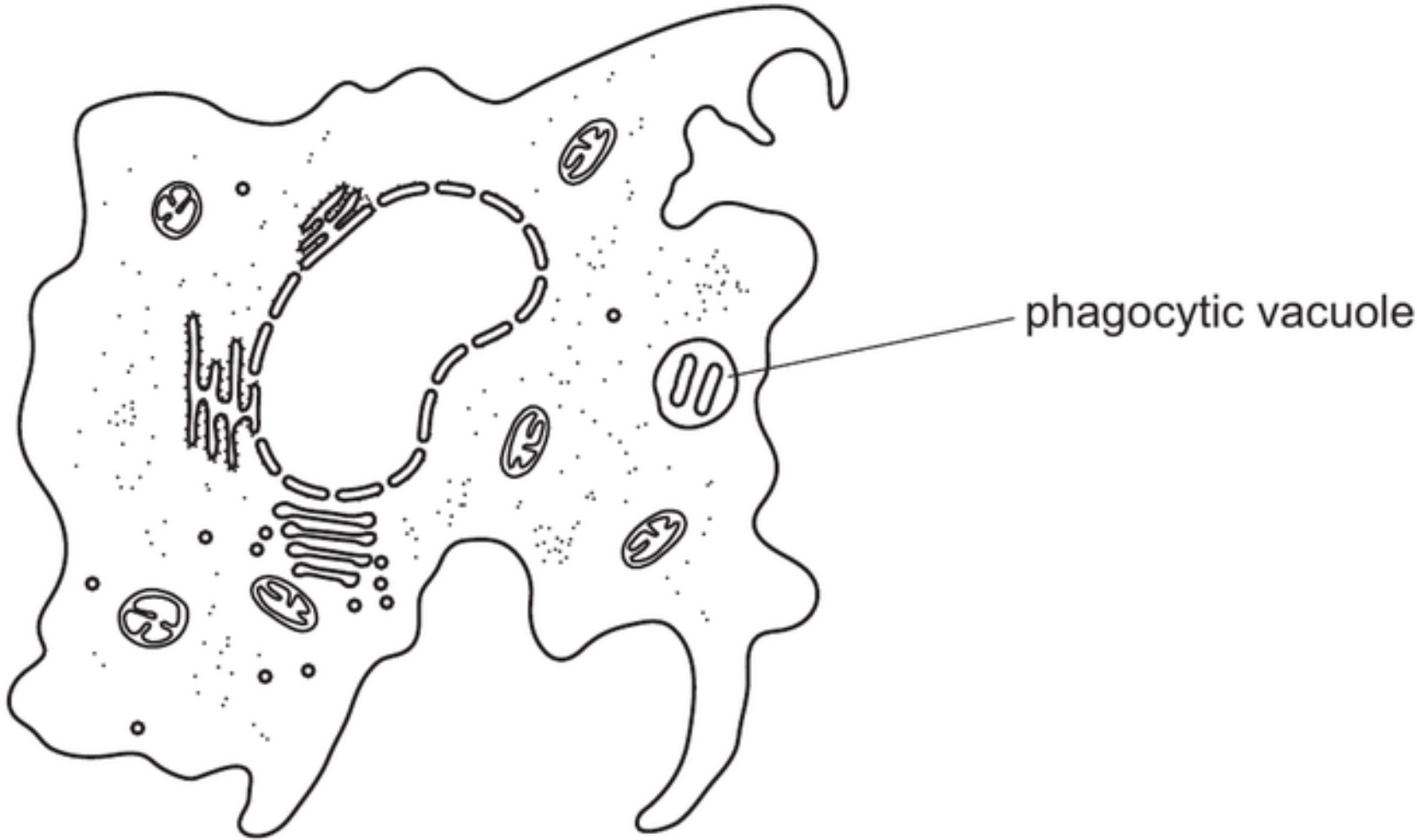


Fig. 2.1

The cell structures with the functions described in Table 2.1 are **not** shown in Fig. 2.1.

Complete Fig. 2.1 by drawing **and** labelling the cell structures described in Table 2.1. [2]



- (b) Tuberculosis (TB) can be prevented if the bacterial cells that have reached the alveoli are rapidly destroyed. Alveolar macrophages can detect the presence of *M. tuberculosis* in the alveolar space and can carry out phagocytosis to form phagocytic vacuoles, such as the one shown in Fig. 2.1.
- (i) Outline the sequence of events that leads to the formation of a phagocytic vacuole after detection of the bacterial cells by an alveolar macrophage.
-
-
-
-
- [2]
- (ii) Name the cell structures that fuse with the phagocytic vacuole and release hydrolytic enzymes to destroy the bacterial cells.
- [1]
- (c) Research has shown that vaccination programmes are cost effective and are very helpful

in the prevention and control of TB. The programmes may be aimed at particular groups of people that are at a high risk of getting the disease, or they may be aimed at an entire population because the country has a high number of cases of TB.

The Bacillus Calmette-Guérin (BCG) vaccine is freeze-dried and contains live, weakened (attenuated) *Mycobacterium bovis*.

Apart from being cost effective, suggest **and** explain the advantages of using the BCG vaccine for the prevention and control of TB.

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..... [4]

[Total: 12]

Question No 9 - (9700_s24_22_1)
Subsection Topics: (a) : 9.1 - The gas exchange system | (b) : 1.1 - The microscope in cell studies | (c) : 8.1 - The circulatory system | (d) : 6.1 - Structure of nucleic acids and replication of DNA, 2.3 - Proteins, 6.2 - Protein synthesis

Smooth muscle is a tissue composed of smooth muscle cells. The cells contain cytoplasm packed with proteins that are involved in contraction and relaxation.

(a) Smooth muscle is present in the airways of the gas exchange system.

Explain how smooth muscle cells in the walls of the **bronchioles** contribute to the function of these airways.

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..... [2]

(b) When viewed in longitudinal section (LS), smooth muscle cells are elongated and taper at both ends. This is known as a fusiform shape. Each cell has a central nucleus, which also appears elongated.

Fig. 1.1 is a diagram of a smooth muscle cell to show the fusiform shape.

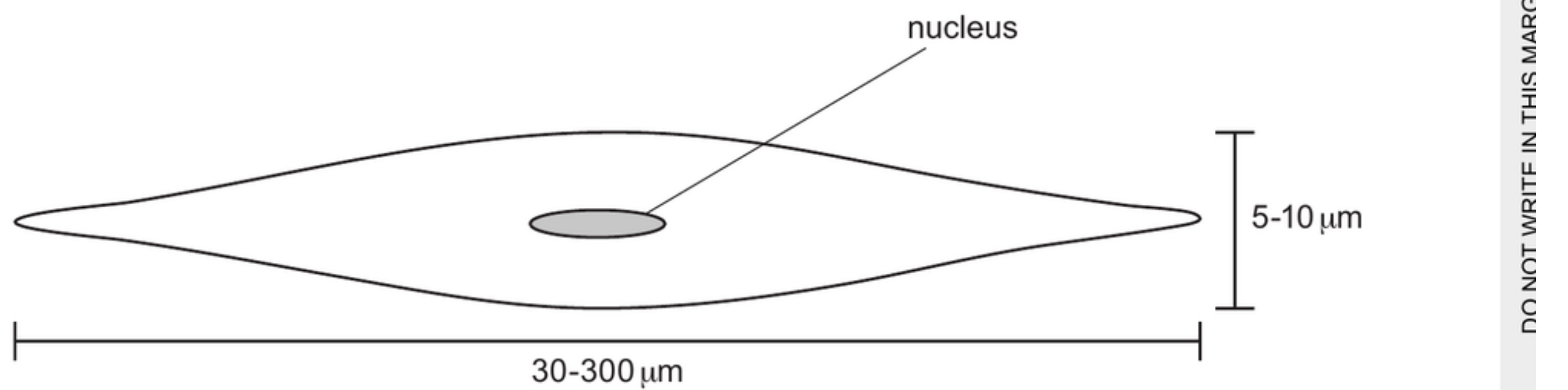


Fig. 1.1

A student used a microscope fitted with a calibrated eyepiece graticule to estimate that the length of one smooth muscle cell was 250 micrometres (μm).

(i) Name the type of microscope slide that the student used to calibrate the eyepiece graticule.

..... [1]

(ii) The smallest object the student can see without the use of a microscope is 0.2mm in length.

Explain whether the student would be able to see a cell of length 250 μm without the use of a microscope.

.....

..... [1]



3



(c) Fig. 1.2 is a photomicrograph of smooth muscle tissue in the wall of the intestines. A capillary is visible in addition to smooth muscle cells.

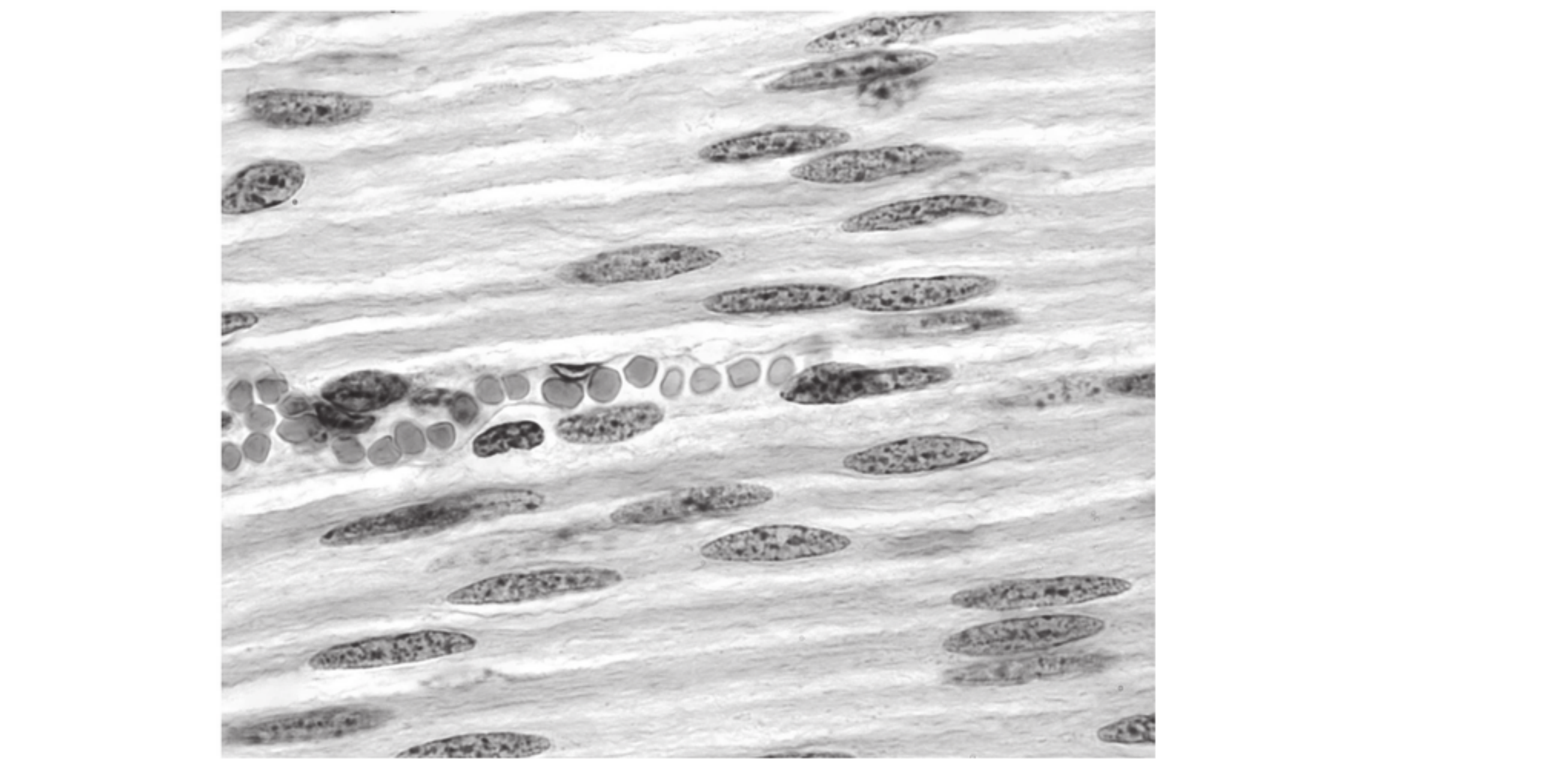


Fig. 1.2

(i) Outline the features that help to identify the blood vessel in Fig. 1.2 as a capillary.

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..... [2]

(ii) Explain how the structure of a capillary is related to its function in smooth muscle.

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..... [3]



4



(d) Caldesmon is a large protein with a number of binding sites to attach to other proteins.

Caldesmon exists in two different forms, H-caldesmon and L-caldesmon.

H-caldesmon helps to regulate contraction and relaxation in smooth muscle cells.

L-caldesmon is found in some non-muscle cells, where it also acts as a regulatory protein.

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- Caldesmon is coded for by a gene known as *CALD1*.
- *CALD1* has 17 exons.
- The primary structure of H-caldesmon has a repeating sequence in the middle of the amino acid chain that is **not** present in L-caldesmon.

(i) Researchers have discovered that a gene mutation is **not** the cause of the two different forms of caldesmon.

Explain what is meant by a gene mutation.

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..... [2]

(ii) Researchers now know that the two different forms of caldesmon are the result of events occurring **directly after** transcription of DNA. Changes occur to the primary transcript that is formed by DNA transcription.

Suggest how the smooth muscle cells and non-muscle cells can produce different forms of caldesmon from the same primary transcript.

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..... [2]

(iii) Suggest how the two different forms of caldesmon can still have similar functions, even though they have a different primary structure.

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..... [1]

The Zika virus is a pathogen that can infect human cells.

(a) Fig. 1.1 is a drawing of the structure of a Zika virus.

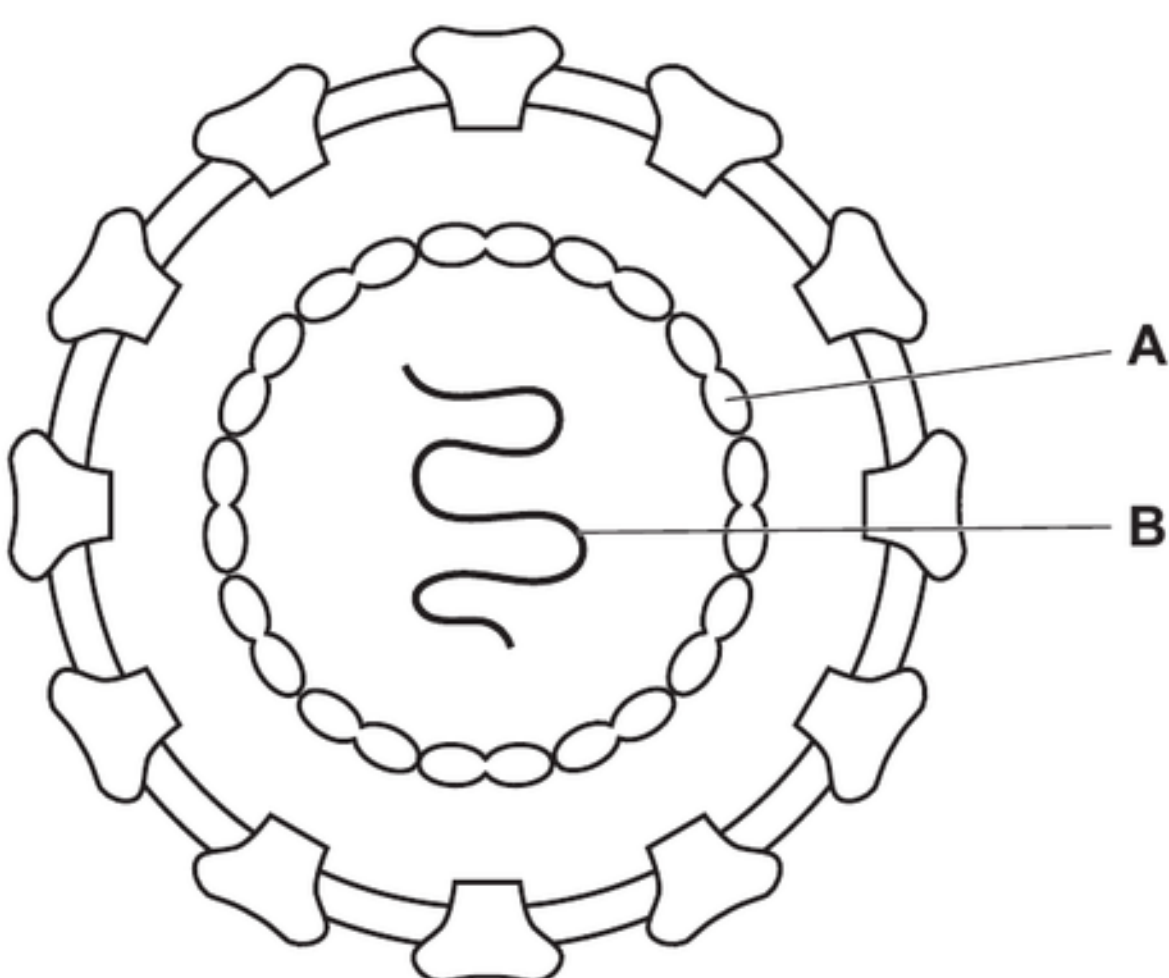


Fig. 1.1

- (i) In Fig. 1.1, structure **A** is made of protein.
- Name structure **A**.
- [1]
- (ii) In Fig. 1.1, structure **B** is a single-stranded molecule.
- Suggest the name of structure **B**.
- [1]

(b) Fig. 1.2 is a transmission electron micrograph of human kidney cells infected with Zika viruses.

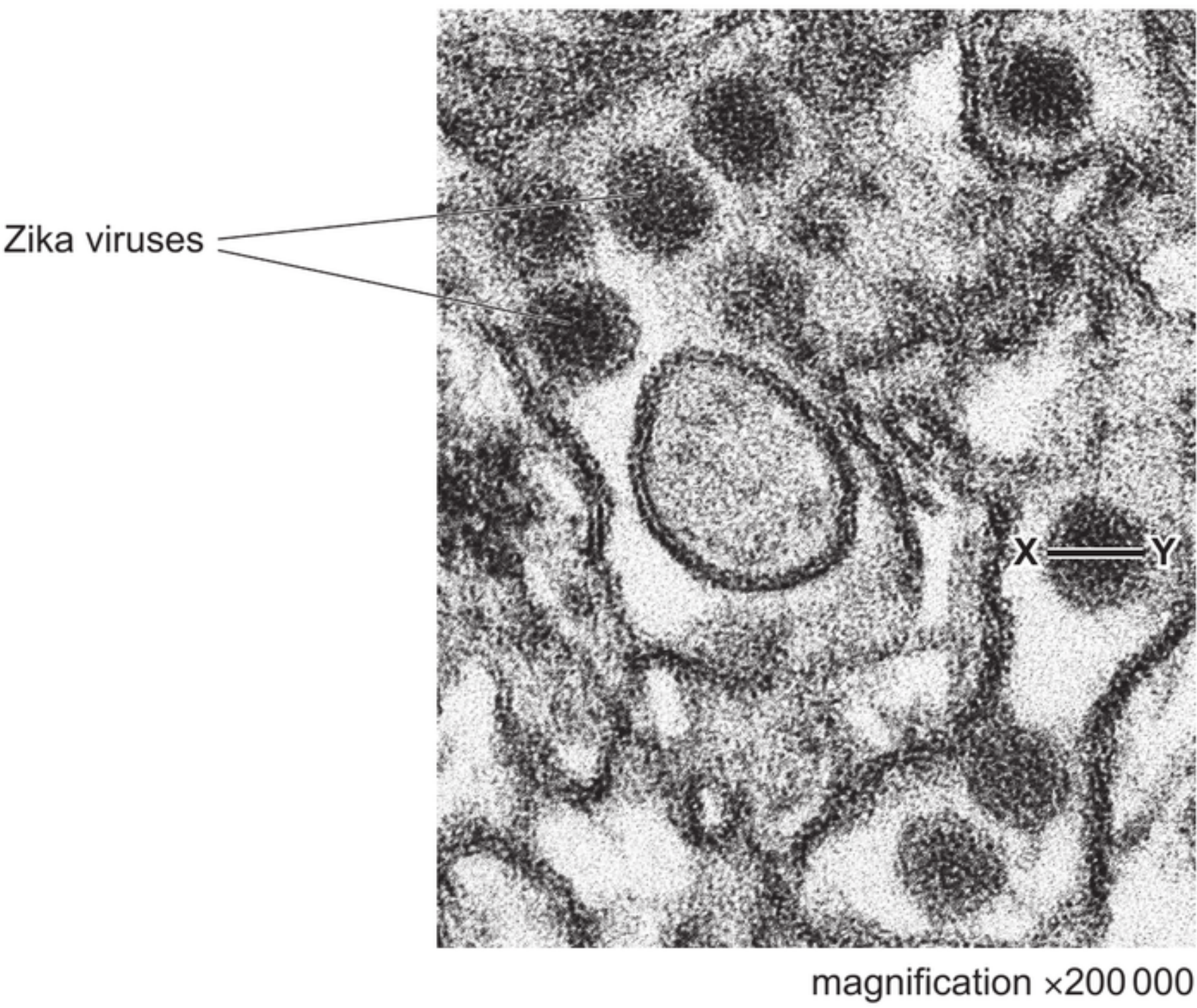


Fig. 1.2

- (i) Calculate the actual diameter of a Zika virus using the line **X–Y** in Fig. 1.2.
- Show your working.
- Give your answer in nanometres (nm).
- diameter = nm [2]
- (ii) A magnification of $\times 200\,000$ cannot be achieved by a light microscope. The resolution of a transmission electron microscope is also higher than a light microscope.
- Describe what is meant by the resolution of a microscope.
-
-
- [1]
- (c) The vector for Zika virus is the mosquito *Aedes aegypti*. The mosquito feeds on the blood of an infected person and transmits the virus to another person when it feeds again.
- Describe the similarities and differences between the transmission of Zika virus disease and the transmission of malaria.
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..... [3]

(d) Zika virus vaccines have been developed by scientists.

One of the vaccines contains small proteins from the Zika virus.

(i) Explain how giving this vaccine to a person can lead to the development of long-term immunity against Zika virus disease.

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..... [4]

(ii) Explain how a vaccination programme may limit the spread of Zika virus disease through a population.

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..... [2]

(a) Fig. 3.1 is a photomicrograph of a transverse section through a region of the wall of the bronchus in the gas exchange system.

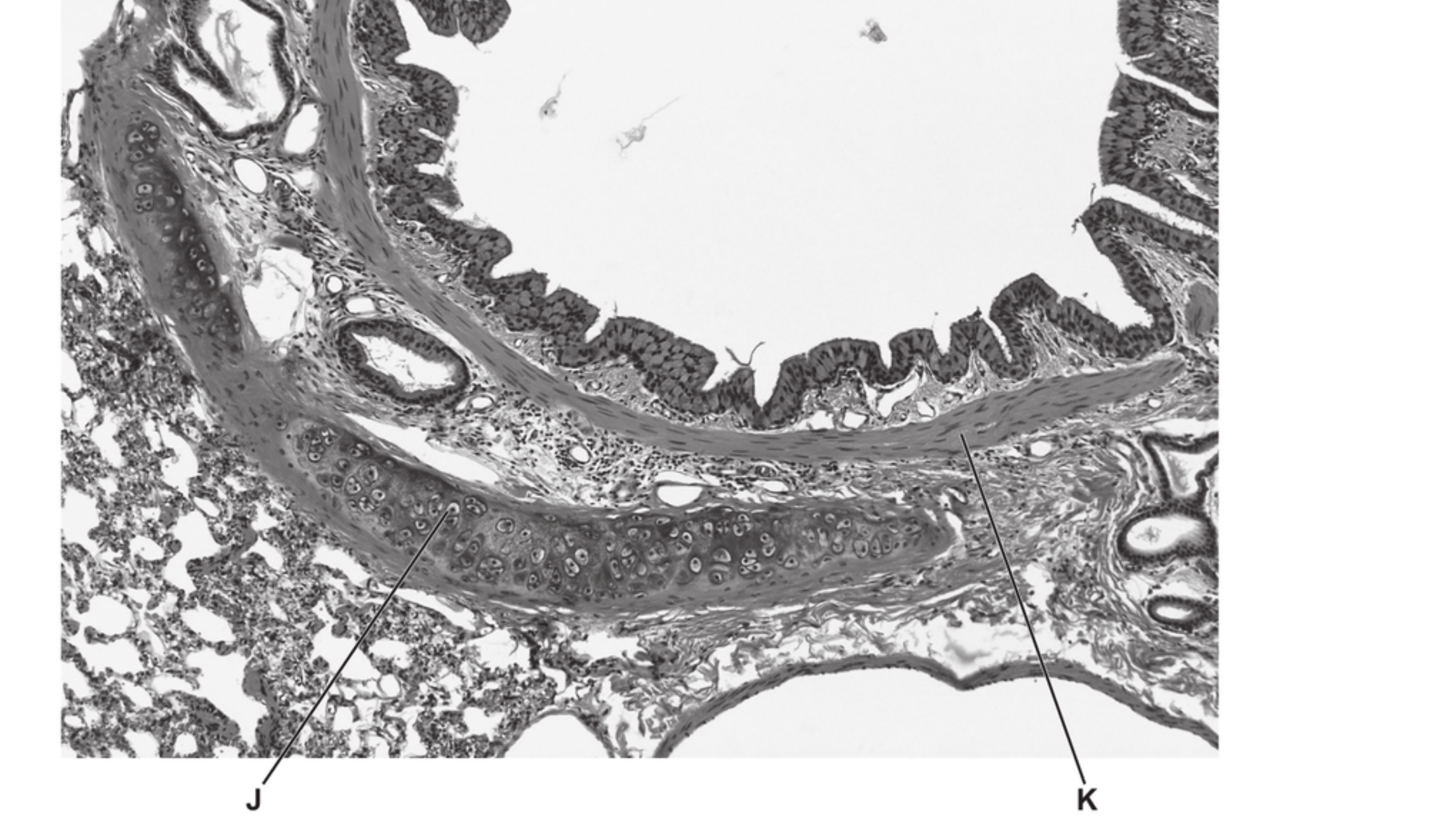


Fig. 3.1

Identify the tissues **J** and **K** shown in Fig. 3.1, **and** suggest how the wall of a bronchiole differs from the wall of the bronchus for these two tissues.

J

K

difference

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[3]

(b) Tuberculosis (TB) is an infectious disease that affects the human gas exchange system.

The pathogen that causes TB secretes a protein that can be detected in saliva.

Early diagnosis of TB is important in reducing the transmission of the pathogen.

Scientists have developed a test strip for TB that uses monoclonal antibodies. Monoclonal antibodies are specific in their action.

This test strip contains:

- mobile monoclonal antibodies that bind to one part of the protein secreted by the pathogen
- immobilised monoclonal antibodies.

Fig. 3.2 shows a simplified diagram of the test strip.

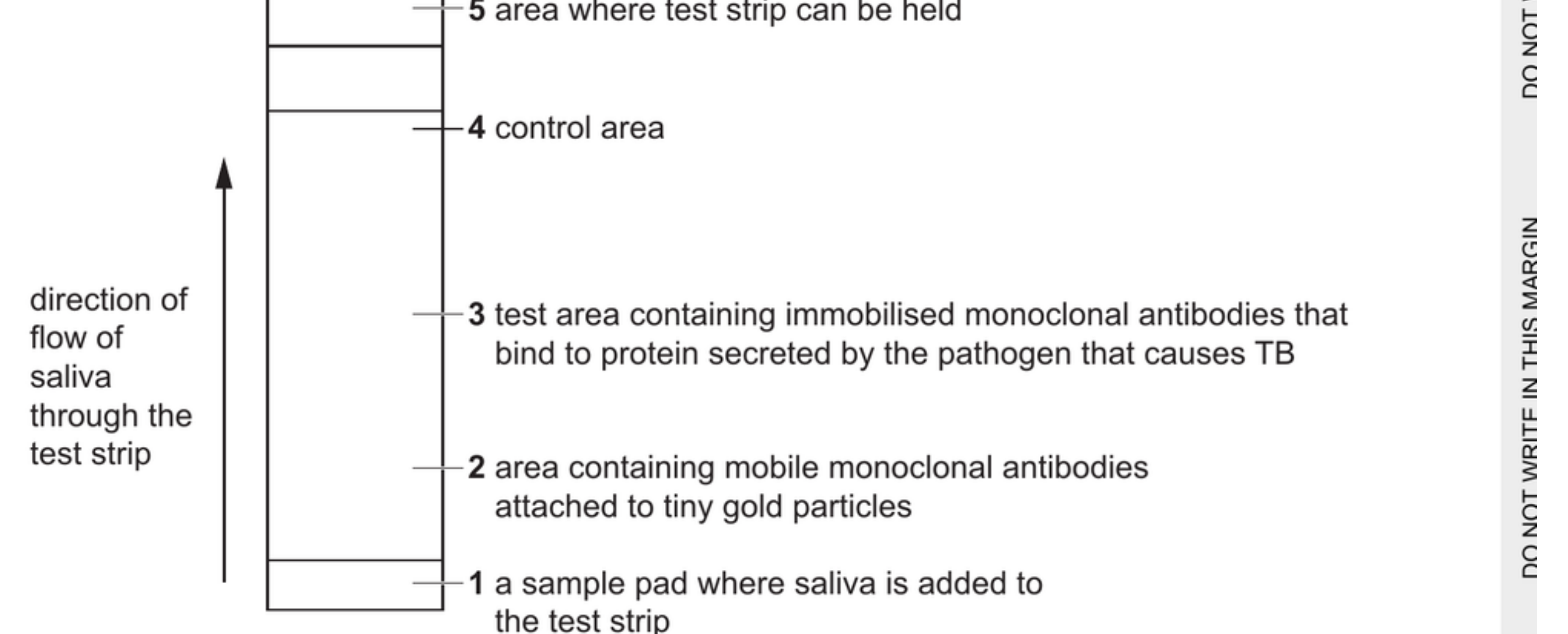


Fig. 3.2

A sample of saliva is collected and put onto the sample pad in the test strip.

The saliva moves up the test strip through area **2**.

The mobile monoclonal antibodies are attached to tiny gold particles. If these antibodies collect in test area **3**, a gold line becomes visible on the test strip.

A gold line that becomes visible in area **4** confirms that the test strip is working and that the results are valid.

(i) State the name of the pathogen that causes TB.

..... [1]

(ii) Name the part of the monoclonal antibody that binds to the protein from the pathogen.

..... [1]

(iii) Saliva is added to a test strip to test for the presence of the protein secreted by the TB pathogen.

Fig. 3.3 is a diagram showing some of the molecules in area **3** of the test strip when a positive result for TB is obtained.

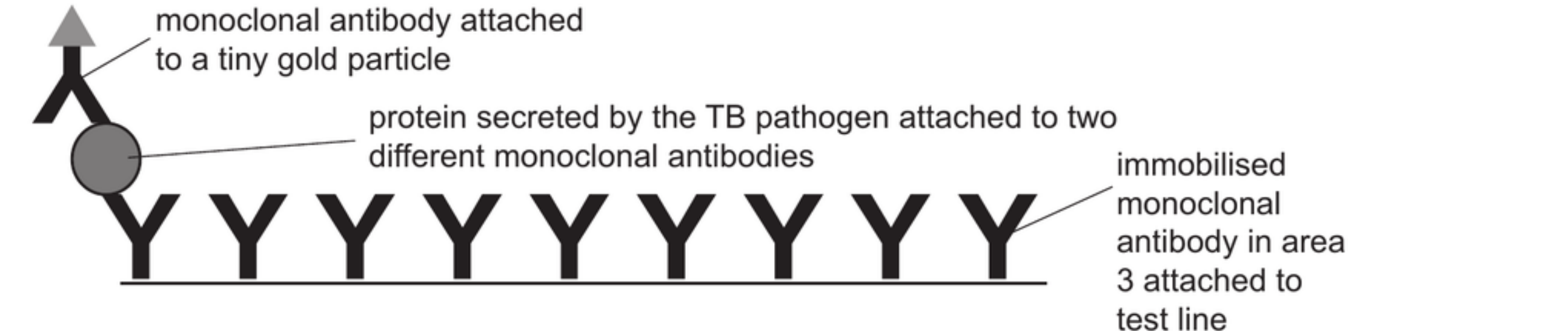


Fig. 3.3

Use the information in Fig. 3.3 to suggest **and** explain why this test is specific for TB.

.....

.....

.....

.....

.....

[2]

(iv) Area **4** contains different immobilised antibodies to those in area **3**.

The mobile monoclonal antibodies bound to tiny gold particles will bind to these immobilised monoclonal antibodies in area **4**.

If the test has functioned correctly, a gold line will be visible in area **4**.

Suggest how the structure of immobilised monoclonal antibodies in area **3** differs from the structure of the immobilised monoclonal antibodies in area **4**.

.....

.....

.....

.....

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

..... [2]



(c) Vaccination is another way of reducing the transmission of infectious diseases such as TB. The BCG vaccine is used to help control the spread of TB. This vaccine contains a weakened strain of the pathogen that causes TB. The BCG vaccine stimulates the development of antigen-specific memory T-lymphocytes.

Explain how memory T-lymphocytes provide protection from TB in a person who has been given a BCG vaccination.

.....
.....
.....
.....
.....
.....
..... [3]

(d) The bladder is the organ in the body used to store urine.

When cells divide uncontrollably in the bladder, a tumour develops. This can lead to bladder cancer.

The BCG vaccine has been used to treat bladder cancer.

The BCG vaccine is introduced into the bladder. The tumour cells take up the weakened pathogens in the vaccine and act as antigen-presenting cells.

(i) Name the process used by the tumour cells to take up the weakened pathogens.

..... [1]

(ii) Suggest how antigen presentation by tumour cells stimulates an immune response that leads to the destruction of the tumour cells.

.....
.....
.....
.....
.....
.....
.....
.....
..... [3]

The structures labelled **P** and **Q** in Fig. 1.1 are involved in the absorption of digested food.

(i) Name the structures labelled **P**.

..... [1]

(ii) Explain how the organelle labelled **Q** in Fig. 1.1 is involved in this process.

.....
.....
.....
.....
..... [2]

[Total: 7]

.....
.....
.....
.....
..... [3]



- (e) *P. jirovecii* produces an enzyme known as 1,3- β -D-glucan synthase. The enzyme catalyses the synthesis of 1,3- β -D-glucan.

The therapeutic drug caspofungin is a non-competitive inhibitor of 1,3- β -D-glucan synthase.

With reference to the mechanism of action of caspofungin, explain how the drug may be useful to treat cases of pneumonia caused by *P. jirovecii*.

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.....
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.....
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.....
.....
..... [5]

Question No 14 - (9700_w24_23_6)
Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 10.1 - Infectious diseases

(a) A student constructed a table to compare the structural features of a plant cell, a prokaryotic cell and a virus.

Complete Table 6.1.

Table 6.1

feature	plant cell	prokaryotic cell	virus
external structure	cell wall composed of cellulose	cell wall composed of	capsid composed of
size of ribosomes	80S and 70S		no ribosomes
nucleic acids	DNA and RNA	DNA and RNA	

[4]

(b) The cholera bacterium releases a protein toxin called cholera^{gen}. The toxin causes the loss of chloride ions and water from epithelial cells into the lumen of the intestine.

Fig. 6.1 shows the events that occur in cells lining the intestine when cholera^{gen} binds to the membrane of one of these cells.

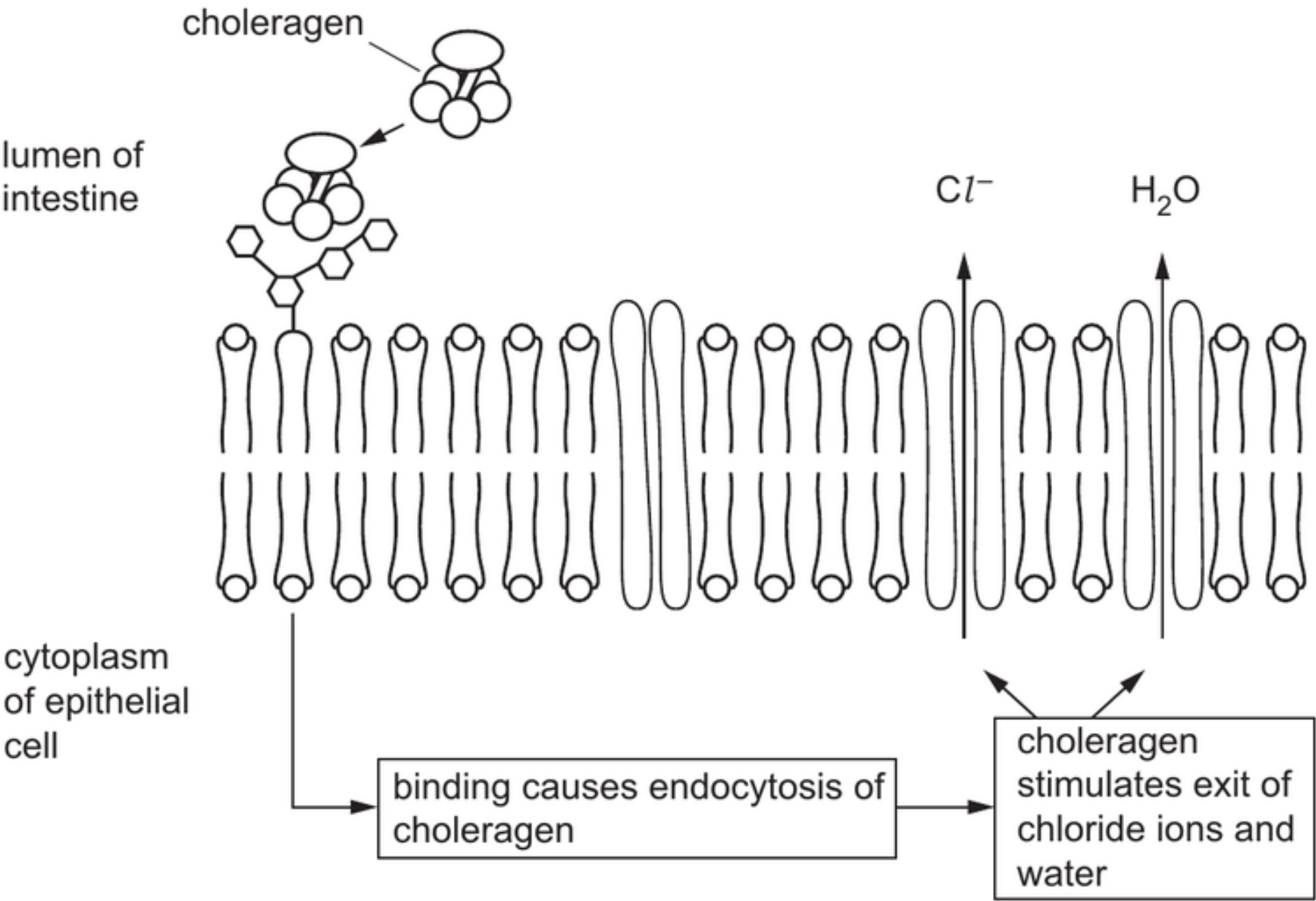


Fig. 6.1

(i) State **one** likely source of an outbreak of cholera.

..... [1]

(ii) With reference to Fig. 6.1, state why cholera^{gen} molecules are described as having quaternary structure.

..... [1]

DO NOT WRITE IN THIS MARGIN

- (iii) State the type of cell membrane component that forms the receptor for cholera toxin.
..... [1]
- (iv) The process by which chloride ions leave the epithelial cell requires energy.
Name the phosphorylated nucleotide that is needed for this process.
..... [1]
- (v) Explain why water also moves from epithelial cells into the lumen of the intestine when cholera toxin is present.
.....
.....
.....
.....
..... [2]

[Total: 10]

Question No 15 - (9700_m23_22_1)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 4.1 - Fluid mosaic membranes | (c) : 5.1 - Replication and division of nuclei and cells

- (a) Table 1.1 lists cell structures that can be found in eukaryotic cells or prokaryotic cells. Some of these cell structures can be found in both types of cell.

Complete the table using a tick (✓) to show that the cell structure can be present in a particular type of cell and a cross (✗) to show that the cell structure **cannot** be present.

Put a tick or a cross in every box.

The top row has been completed for you.

Table 1.1

cell structure	eukaryotic cells	prokaryotic cells
nucleus	✓	✗
Golgi body		
circular DNA		
70S ribosome		

[2]

- (b) All cells have a cell surface membrane. Fig. 1.1 shows a transmission electron micrograph of part of **two** adjacent animal cells, cell 1 and cell 2.

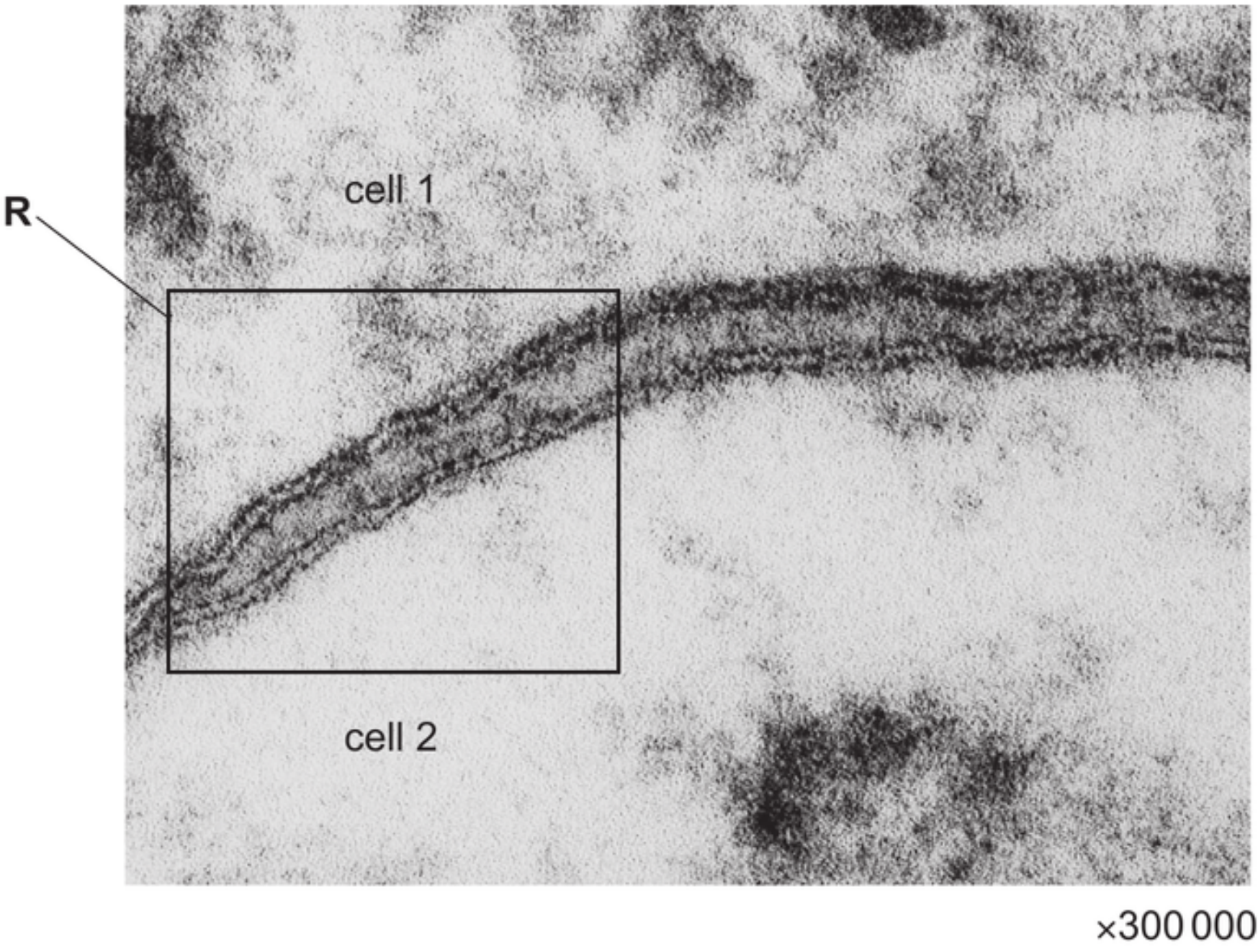


Fig. 1.1

In the space provided, draw a diagram of the region in the box labelled **R** on Fig. 1.1. Your diagram should show the four dark lines.

Label the diagram to identify what is shown by the dark lines and each of the three spaces between them.

space for diagram:

(c) Mitogens are short chains of amino acids that function as cell-signalling molecules. Mitogens are released from secretory cells and travel in the blood to target cells, where the mitogens bind to cell surface receptors. The target cells respond by progressing from the G_1 phase to the S phase of the mitotic cell cycle.

(i) Outline what happens in the G_1 phase and S phase of the mitotic cell cycle.

G_1 phase

.....

.....

S phase

.....

.....

[2]

(ii) As a result of mutation, the production and release of mitogens into the blood can be greatly increased.

Suggest a possible consequence for target cells of increased concentrations of mitogens in the blood.

.....

.....

..... [1]

[Total: 8]

Question No 16 - (9700_s23_21_1)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 2.3 - Proteins | (c) : 11.1 - The immune system

Fig. 1.1 is a transmission electron micrograph of a cell from the stem of sago pondweed, *Stuckenia pectinata*.

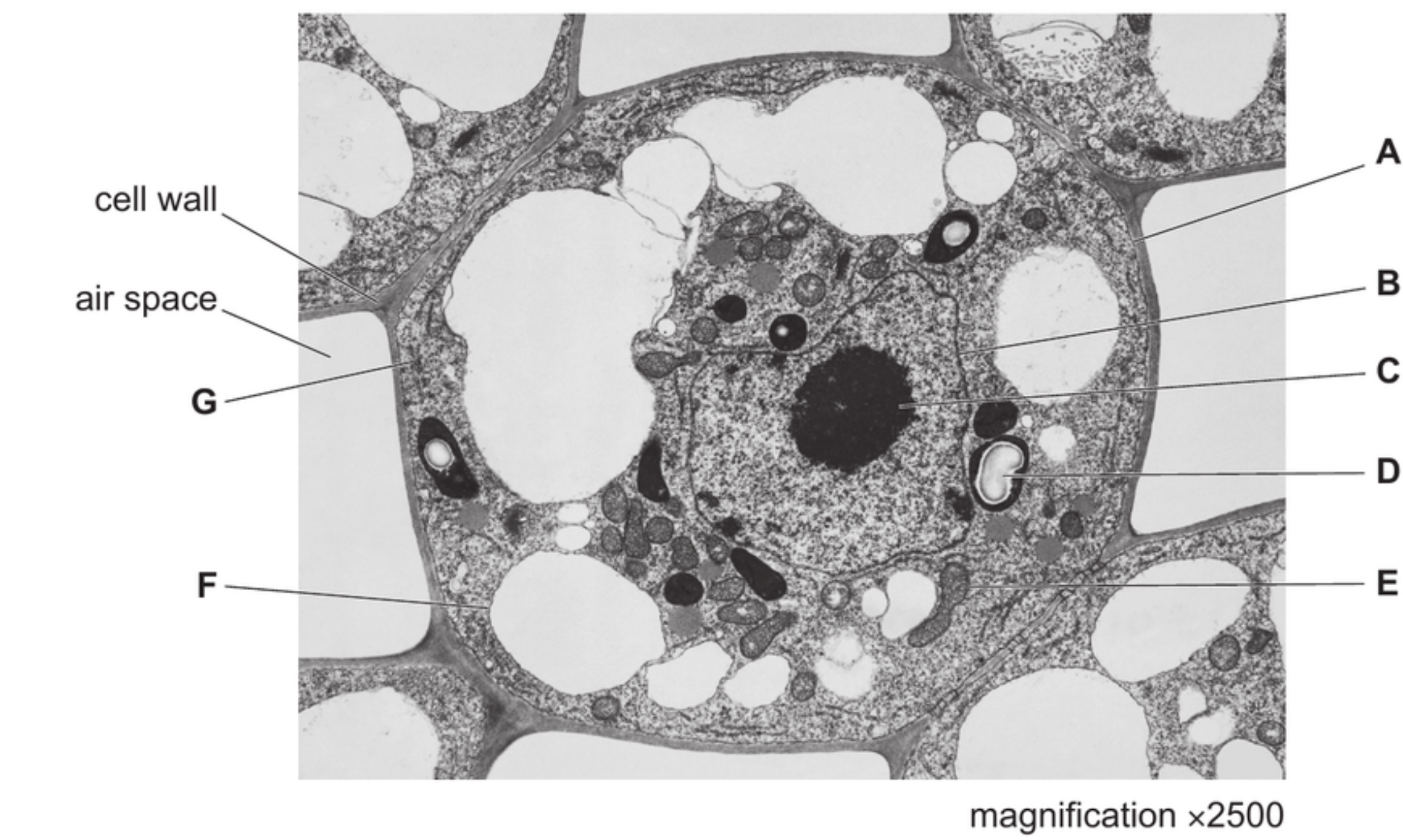


Fig. 1.1

- (a) (i) State the evidence from Fig. 1.1 that shows that the cell is from the stem of *S. pectinata* and **not** from the mesophyll of a leaf.
-
- [1]
- (ii) Complete each row in Table 1.1 to identify a cell structure shown in Fig. 1.1 that carries out the function listed.

Table 1.1

function	name of cell structure	letter on Fig. 1.1
gas exchange		
production of subunits of ribosomes		
active transport of ions		
aerobic respiration		

[4]

- (b) Plant vacuoles develop when vesicles fuse together. The vacuoles increase in size as more vesicles fuse.

Fig. 1.2 shows the movement of vesicles within a plant cell during the development of a vacuole.

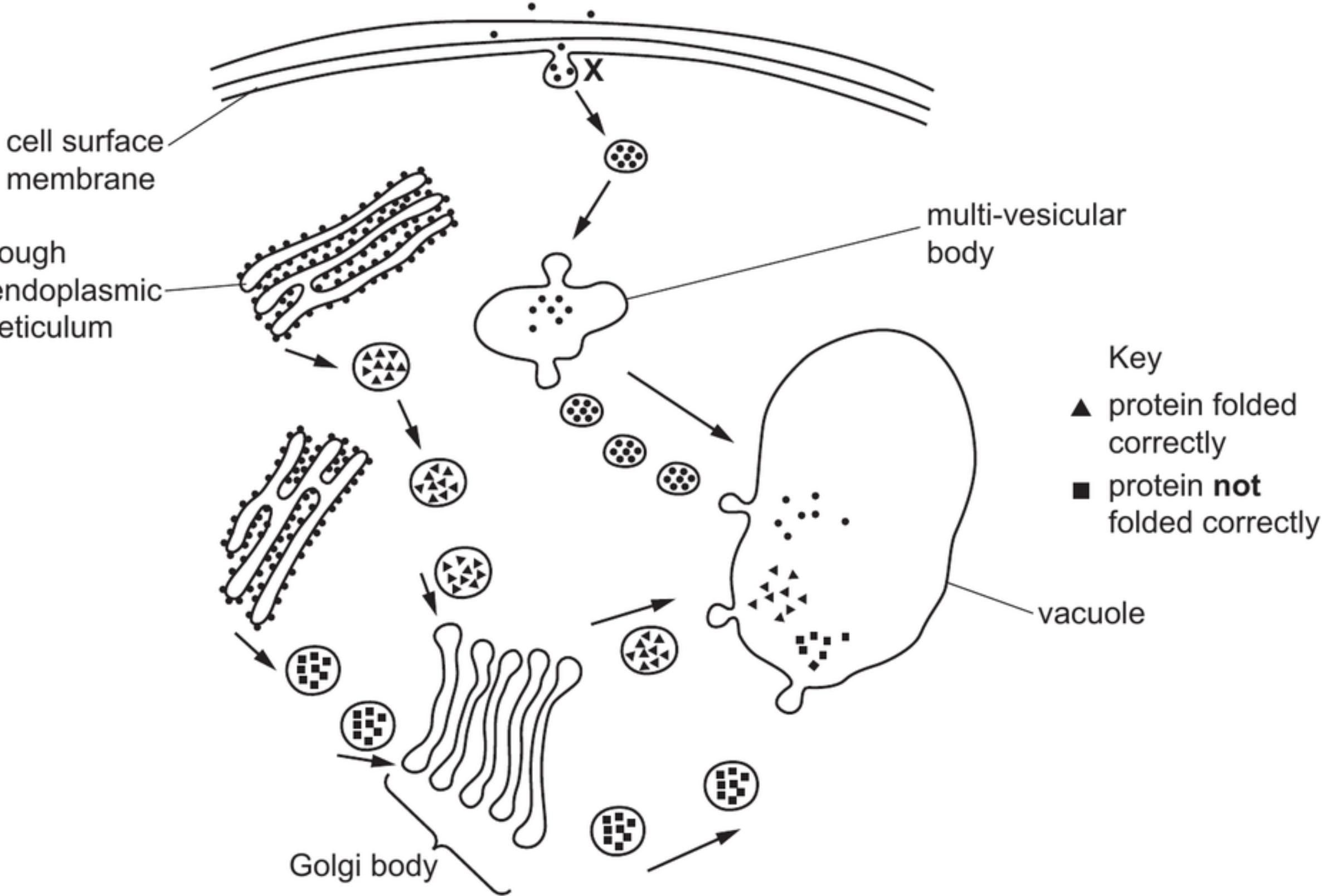


Fig. 1.2

(i) Name the process that is occurring at **X**.

..... [1]

(ii) Some of the vesicles formed by the Golgi body pass to the vacuole. These vesicles contain proteins that have been folded correctly and some that have **not** folded into their correct shapes. The proteins that have **not** folded correctly pass to the vacuole where they are broken down.

Explain how proteins that have **not** folded correctly are broken down in the vacuole.

.....
.....
.....
.....
.....
.....

(c) Small vacuoles in *S. pectinata* may have roles similar to lysosomes in animal cells.

Describe the role of lysosomes in animal cells in defence against pathogens.

.....
.....
.....
.....
.....
..... [2]

Question No 17 - (9700_s23_22_4)

Subsection Topics: (a) : 6.2 - Protein synthesis | (b) : 10.1 - Infectious diseases | (c) : 10.1 - Infectious diseases

Trypanosoma brucei is a unicellular organism that causes the infectious disease known as sleeping sickness. Insects known as tsetse flies pass on the organism from infected people to uninfected people when male and female tsetse flies feed on human blood.

(a) Fig. 4.1 is a transmission electron micrograph of the form of *T. brucei* found in human blood.

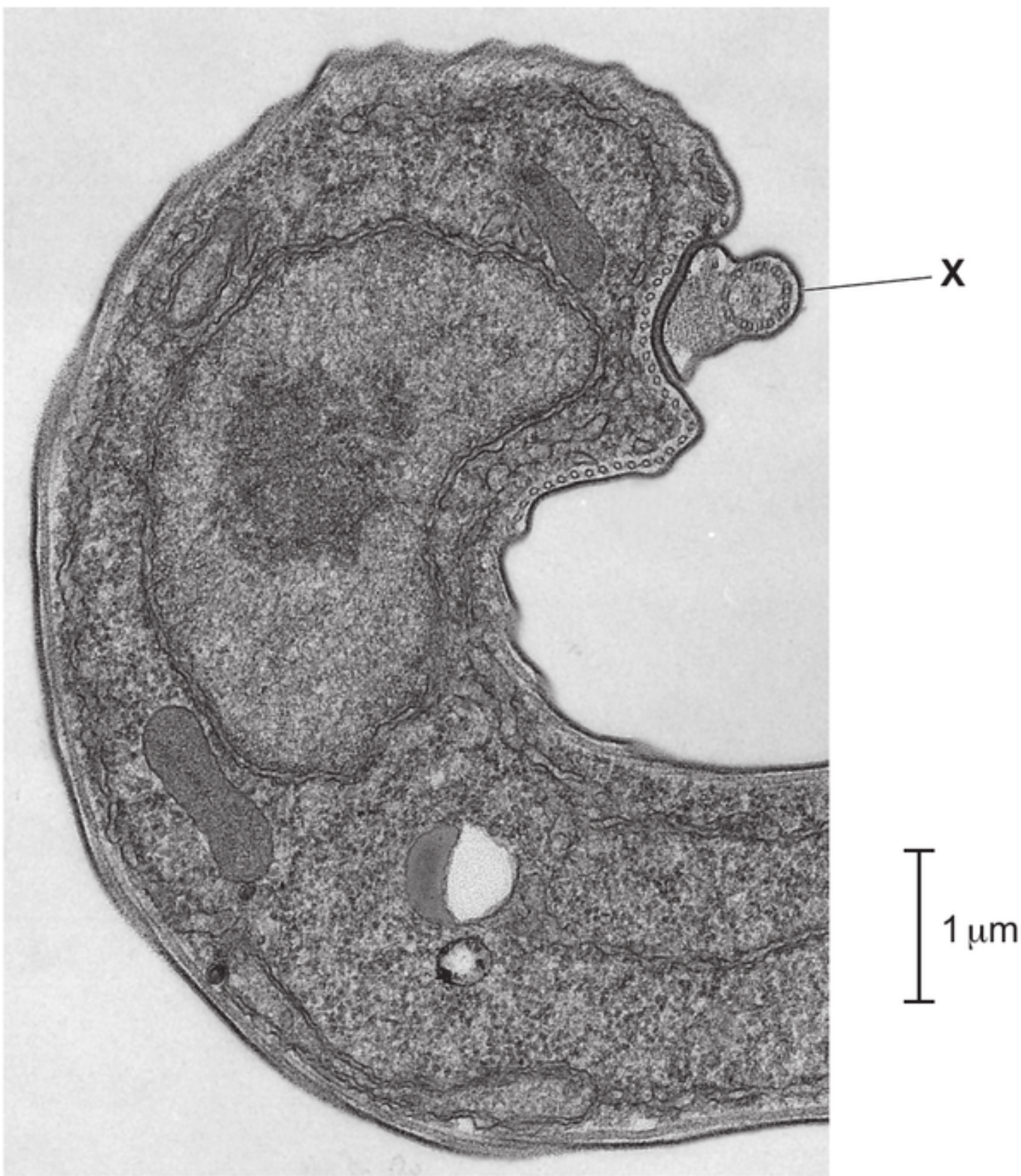


Fig. 4.1

- (i)** Draw an arrow on Fig. 4.1 to indicate the location in the cell where ribosomal RNA (rRNA) and proteins are assembled to make ribosomal subunits. [1]
- (ii)** With reference to Fig. 4.1, explain how the structure labelled **X** provides evidence that *T. brucei* is motile (able to move). [2]
-
-
-
-
-
-
- (iii)** With reference to Fig. 4.1, explain whether *T. brucei* is a eukaryote or prokaryote. [3]
-
-
-
-
-
-
-
-
- (b)** Malaria is an infectious disease caused by organisms belonging to the genus *Plasmodium*.
- (i)** State the term used to describe an organism that causes disease.

..... [1]

(ii) Name **one** of the species of *Plasmodium* that causes malaria.

Plasmodium [1]

(c) Outline the similarities **and** differences between the modes of transmission of malaria and sleeping sickness.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 11]

Question No 18 - (9700_s23_23_3)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 8.2 - Transport of oxygen and carbon dioxide

Blood contains white blood cells and red blood cells.

(a) Fig. 3.1 is a photomicrograph showing different types of blood cell.

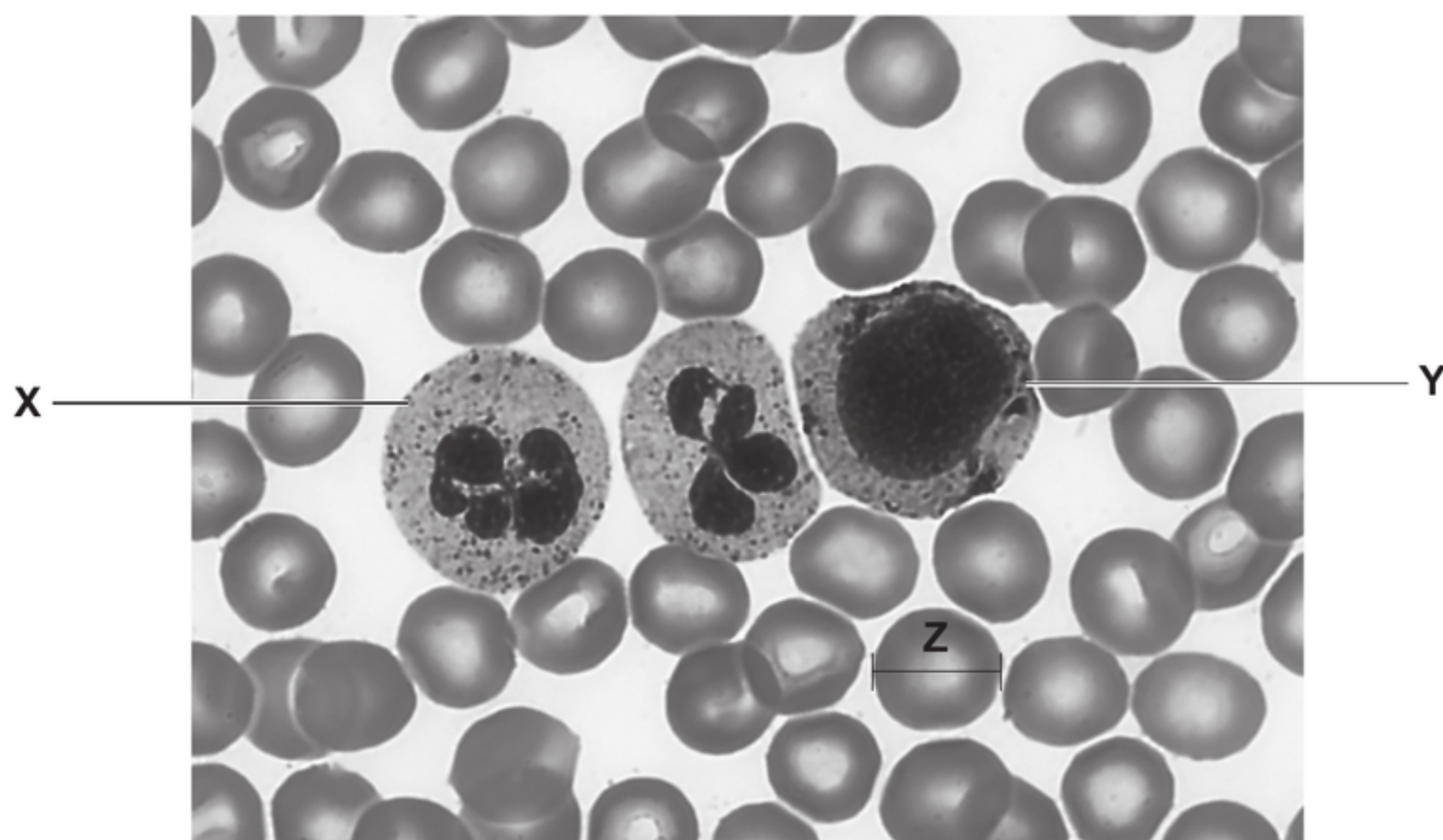


Fig. 3.1

(i) Identify cell **X** and cell **Y** in Fig. 3.1.

X

Y

[2]

(ii) The width of one of the cells in Fig. 3.1 is represented by the line **Z**.

The actual width of cell **Z** is 8 μm .

Calculate the magnification used to produce the image shown in Fig. 3.1.

Write down the formula you will use to make your calculation.

formula

magnification = x [2]

(b) Carbonic anhydrase is an enzyme found in red blood cells.

(i) Describe how carbonic anhydrase is involved in the release of oxygen from red blood cells at respiring tissues.

..... [4]

[4]

- (ii) Sulfonamide is a competitive inhibitor of carbonic anhydrase.

Fig. 3.2 shows the effect of increasing substrate concentration on the rate of the reaction catalysed by carbonic anhydrase.

Sketch a curve **on Fig. 3.2** to show the effect of sulfonamide on the rate of reaction catalysed by carbonic anhydrase.

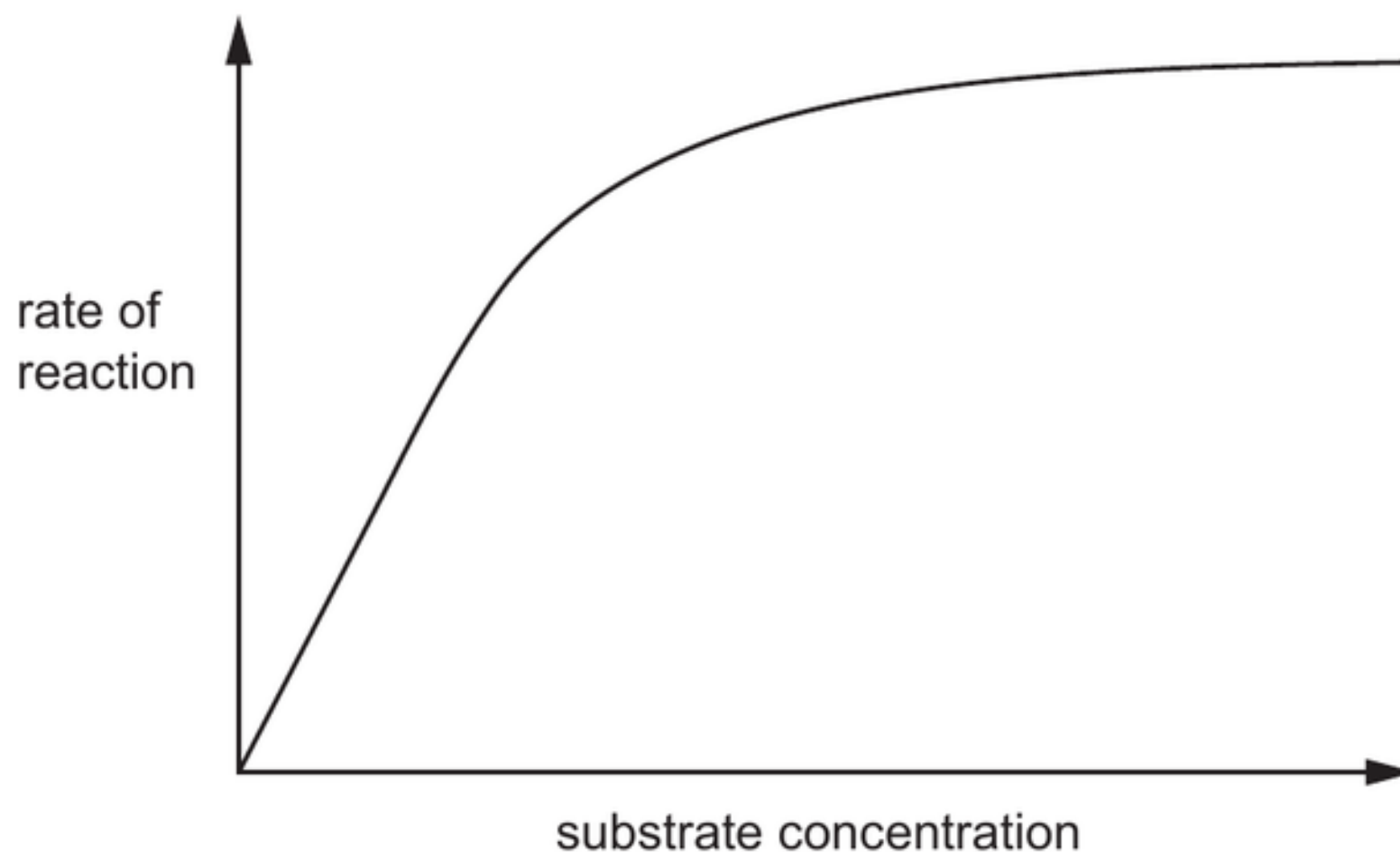


Fig. 3.2

[2]

[Total: 10]

Question No 19 - (9700_s23_23_2)

Subsection Topics: (a) : 10.1 - Infectious diseases | (b) : 10.2 - Antibiotics | (c) : 9.1 - The gas exchange system

The number of cases of tuberculosis (TB) is affected by many biological, social and economic factors.

(a) The number of reported cases of TB in the USA between 1980 and 2000 is shown in Fig. 2.1.

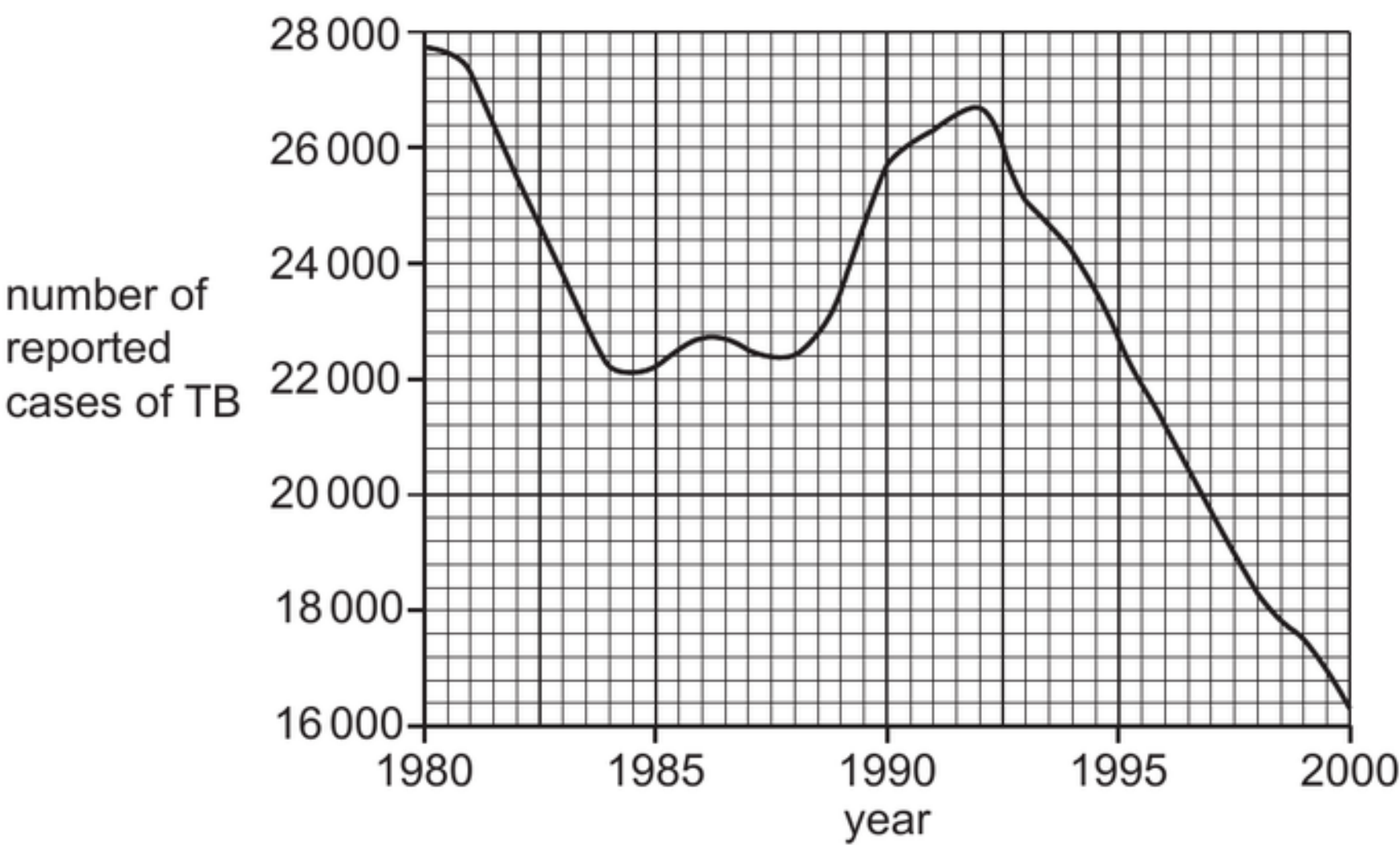


Fig. 2.1

(i) Describe the trends shown in Fig. 2.1 between 1980 and 2000.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) The number of reported cases of TB between 1984 and 1992 in the USA may have been affected by an increase in the number of people infected with HIV.

Explain how an increase in the number of people infected with HIV could have affected the number of TB cases.

.....

.....

.....

.....

121

(b) *Mycobacterium tuberculosis* is a species of bacterium that causes TB. Strains of *M. tuberculosis* have evolved resistance to some of the antibiotics used to treat the disease.

State **two** ways that the impact of antibiotic resistance can be reduced.

1

.....

2

.....

[2]

(c) TB can affect every part of the human gas exchange system, including the trachea, bronchi and alveoli.

(i) The cartilage in the bronchi can be damaged in some people with TB.

Suggest the effect that damage to cartilage may have on the bronchi.

.....

..... [1]

(ii) Table 2.1 shows four types of cell and three structures found in the gas exchange system.

Complete Table 2.1 to show the distribution of cell types in each structure of the gas exchange system.

Use a tick (✓) if the cell type is present in the structure and a cross (X) if the cell type is **not** present.

Put a tick (✓) or a cross (X) in every box.

Table 2.1

cell type	alveolus	bronchus	trachea
iliated epithelial cell			
oblet cell			
nooth muscle cell			
quamous epithelial cell			

[3]

Question No 20 - (9700_w23_21_5)

Subsection Topics: (a) : 9.1 - The gas exchange system | (b) : 1.2 - Cells as the basic units of living organisms, 11.1 - The immune system

Fig. 5.1 is a photomicrograph of a transverse section of a bronchus in the lungs.

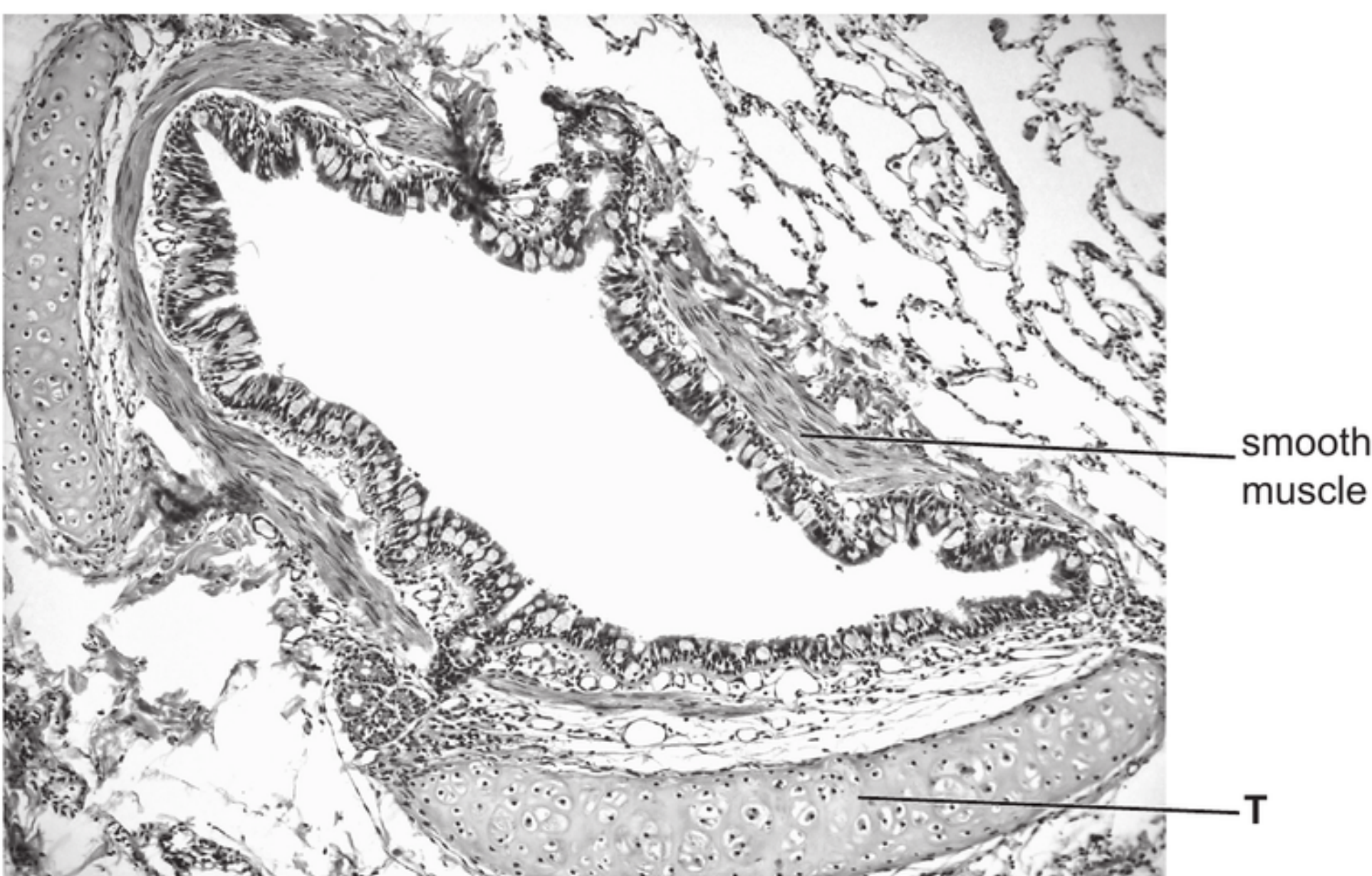


Fig. 5.1

- (a) (i) Identify the tissue labelled T in Fig. 5.1.

..... [1]
- (ii) Describe the function of smooth muscle in the bronchus.

.....

.....

.....

.....

..... [2]

(b) The walls of alveoli contain some specialised epithelial cells called type II epithelial cells. These cells secrete surfactant. Surfactant helps to prevent the alveoli collapsing during breathing.

Surfactant contains phospholipid, cholesterol and protein.

The components of surfactant are synthesised in the rough endoplasmic reticulum and smooth endoplasmic reticulum and then passed to the Golgi body.

The surfactant that is produced is stored in secretory organelles called lamellar bodies.

The surfactant in the lamellar bodies is released onto the surface of the alveolar epithelium by exocytosis, as shown in Fig. 5.2.

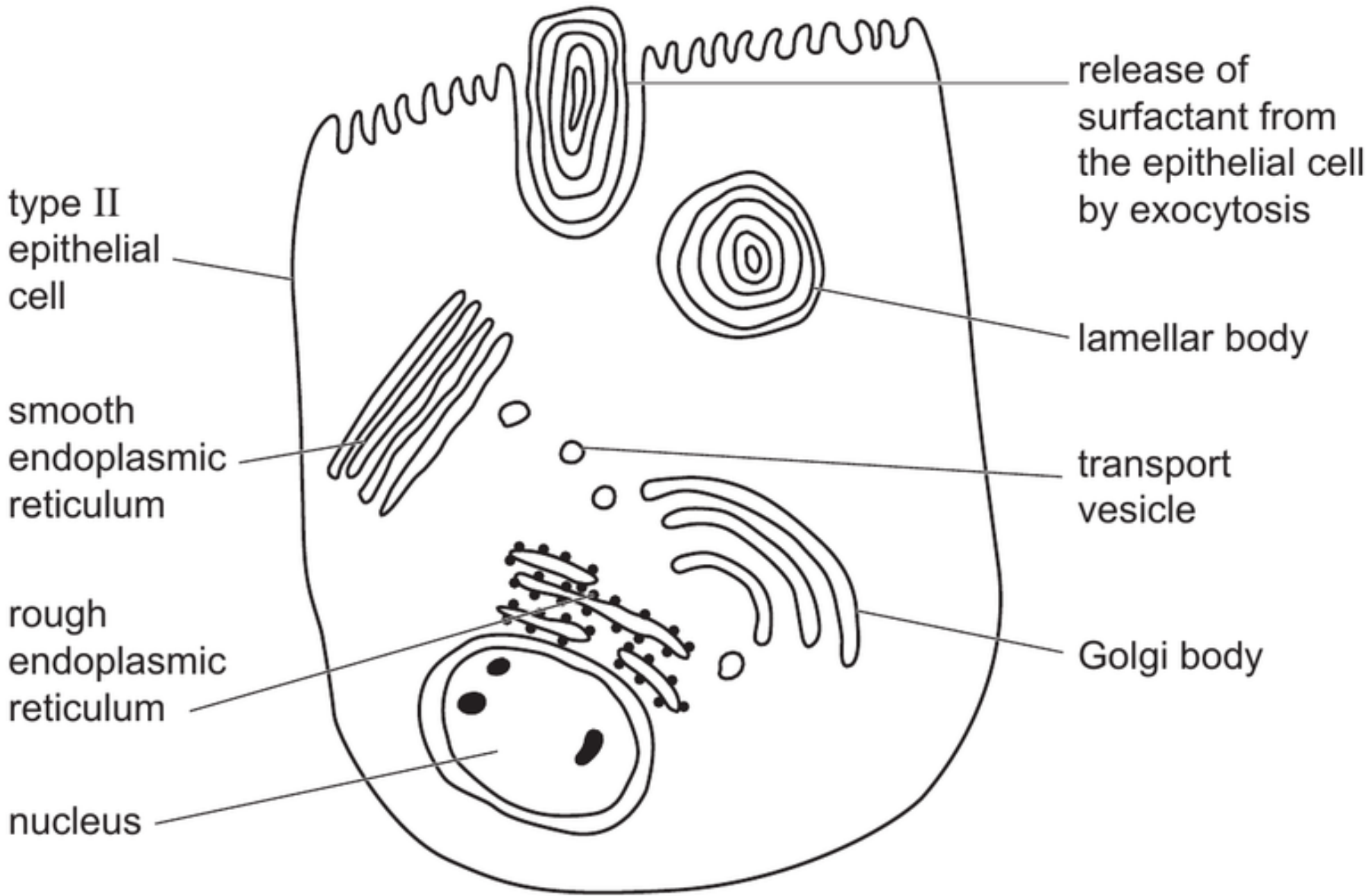


Fig. 5.2

(i) Each lamellar body is surrounded by a single membrane.

Draw a diagram to show the arrangement of phospholipid molecules in the membrane surrounding the lamellar body.

(ii) Scientists studying the production and secretion of lung surfactant have discovered that a reduction in cholesterol in the cell surface membrane of type II epithelial cells reduces the secretion of surfactant.

Suggest why secretion of surfactant is affected by a reduction in cholesterol in the cell surface membranes of type II epithelial cells.

.....

.....

.....

.....

..... [2]

(iii) Lung surfactant is engulfed by macrophages that are in close contact with the type II epithelial cells.

Suggest why macrophages engulf surfactant.

.....

..... [1]

Question No 21 - (9700_w23_21_2)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 2.3 - Proteins, 2.2 - Carbohydrates and lipids, 11.1 - The immune system | (c) : 6.1 - Structure of nucleic acids and replication of DNA, 6.2 - Protein synthesis

Fig. 2.1 is a transmission electron micrograph showing a section of a specialised epithelial cell found in the lining of the stomach. This cell produces extracellular proteins that are released into the bloodstream.

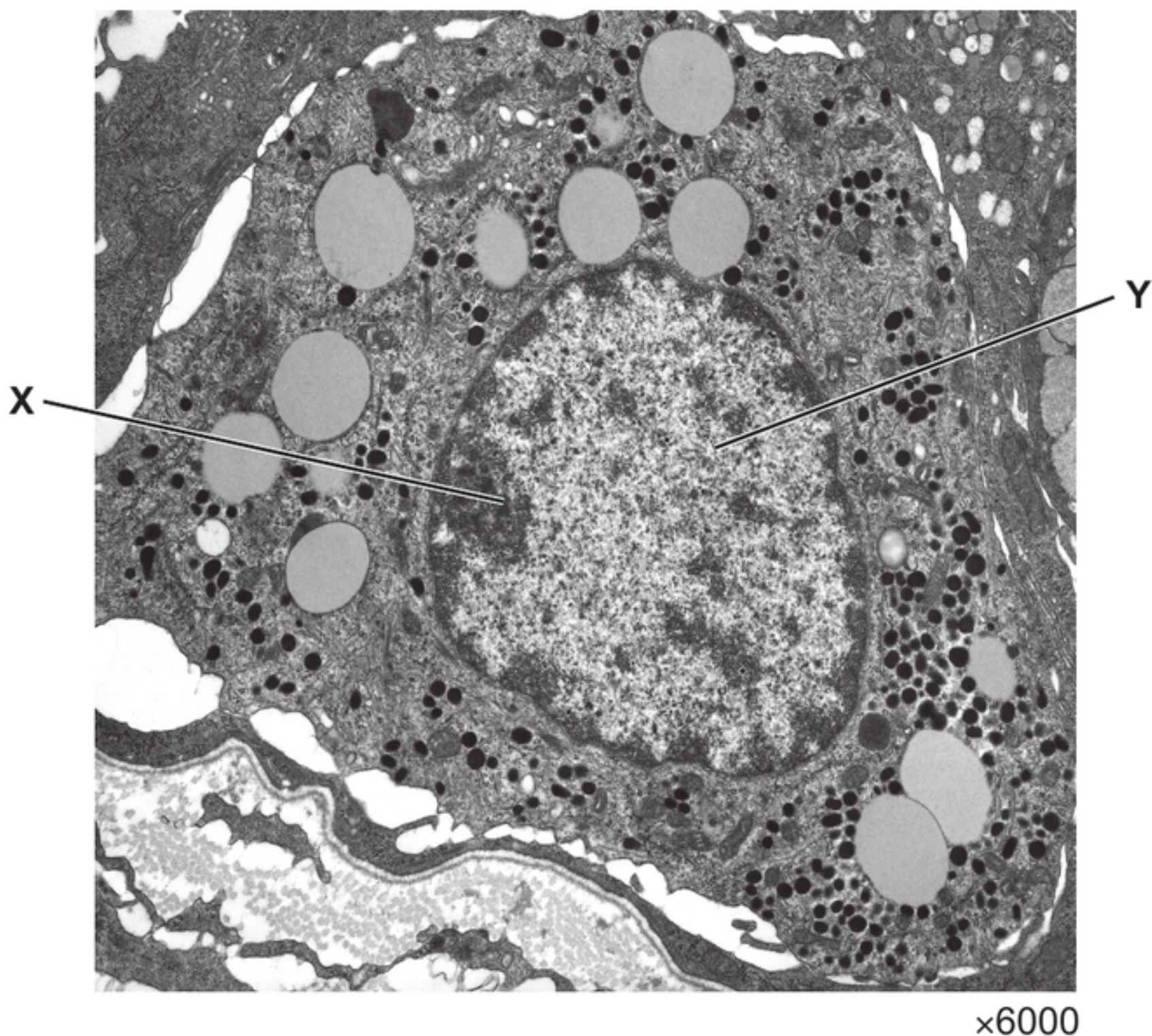


Fig. 2.1

(a) Outline the role of structure X and structure Y, as shown in Fig. 2.1, in the production of extracellular proteins.

structure X

.....

.....

structure Y

.....

.....

[2]

(b) The cell in Fig. 2.1 releases ghrelin, a small protein that acts as a cell signalling molecule.

Fig. 2.2 shows the sequence of amino acids in a ghrelin molecule.

The amino acid serine (Ser) in position 3 in Fig. 2.2 has been modified by the addition of a saturated fatty acid chain.

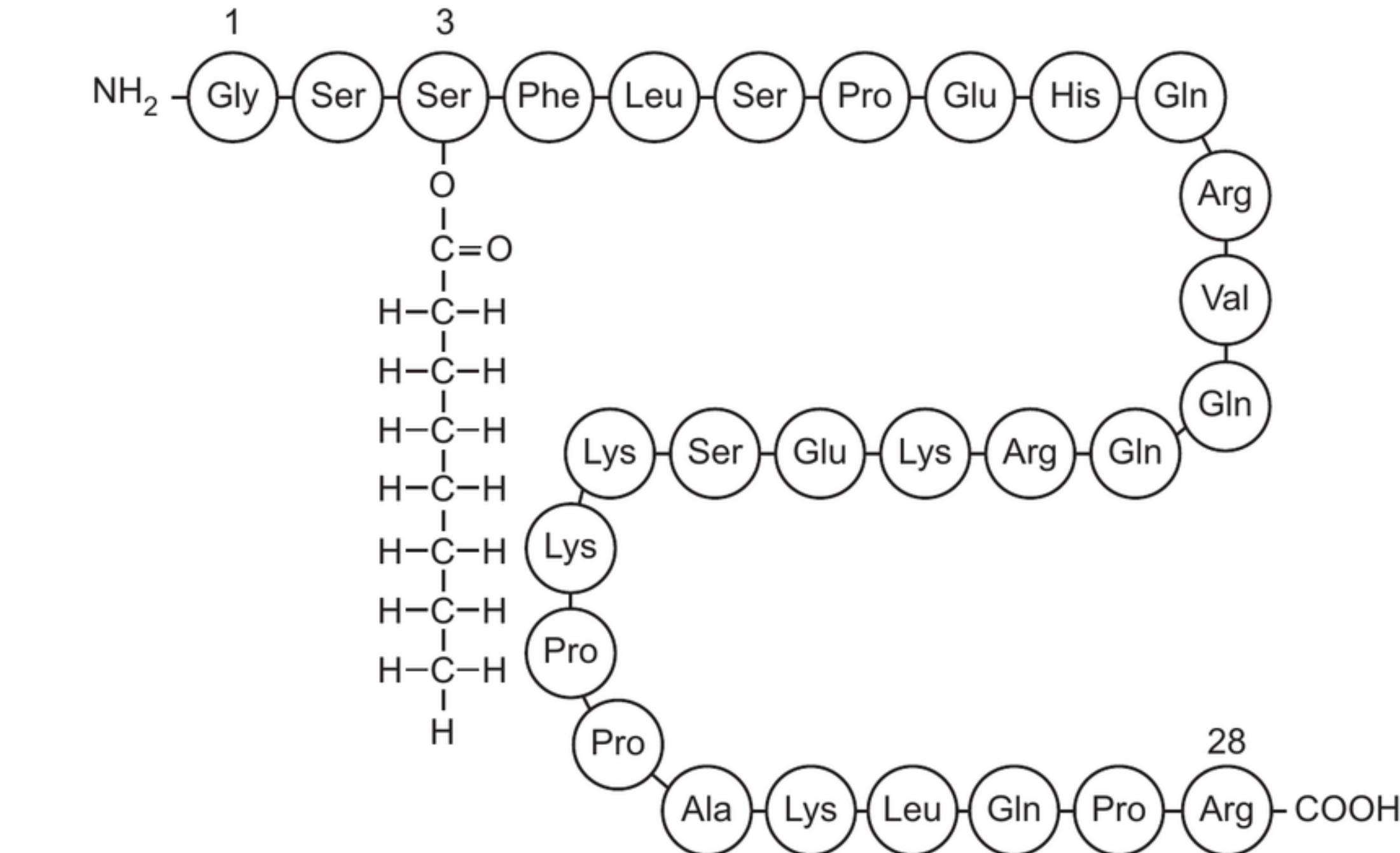


Fig. 2.2

(i) State the level of protein structure shown in Fig. 2.2.

..... [1]

(ii) State **one** similarity between the structure of a saturated fatty acid molecule and an amino acid molecule.

.....

.....

..... [1]

(iii) The addition of the fatty acid chain allows ghrelin to function as a cell signalling molecule.

Suggest how the addition of this fatty acid chain allows a ghrelin molecule to act as a cell signalling molecule.

.....

.....

.....

.....

.....

.....

..... [3]

(c) Scientists have discovered that the gene coding for ghrelin contains 5000 base pairs. This is a much larger number of base pairs than is needed to code for the ghrelin molecule shown in Fig. 2.2.

(i) Calculate the percentage of base pairs found in the gene that codes for the ghrelin molecule shown in Fig. 2.2.

Show your working and give your answer to one decimal place.

..... [2]

(ii) The primary transcript produced from the ghrelin gene is a longer molecule than the mRNA found in the cytoplasm.

Explain how the primary transcript is modified before translation.

Question No 22 - (9700_w23_22_3)
Subsection Topics: (a) : 8.1 - The circulatory system | (b) : 4.2 - Movement into and out of cells, 11.1 - The immune system | (c) : 1.2 - Cells as the basic units of living organisms, 6.2 - Protein synthesis, 2.3 - Proteins

The liver receives blood from the hepatic artery and from the hepatic portal vein. The hepatic portal vein transports blood from the digestive system.

Hepatocytes are the main cell type of the liver. They have a wide range of functions, including:

- the synthesis of triglycerides and plasma proteins
- detoxifying waste
- energy storage.

(a) The hepatic artery branches from the main artery that transports blood from the heart.

Name the main artery that transports blood to the hepatic artery.
..... [1]

(b) Blood arriving at the liver enters specialised blood vessels known as sinusoids.

Fig. 3.1 is a diagram of part of a sinusoid and surrounding hepatocytes. A second type of cell found in the liver, a Kupffer cell, is also shown.

Kupffer cells are phagocytic cells of the immune system.

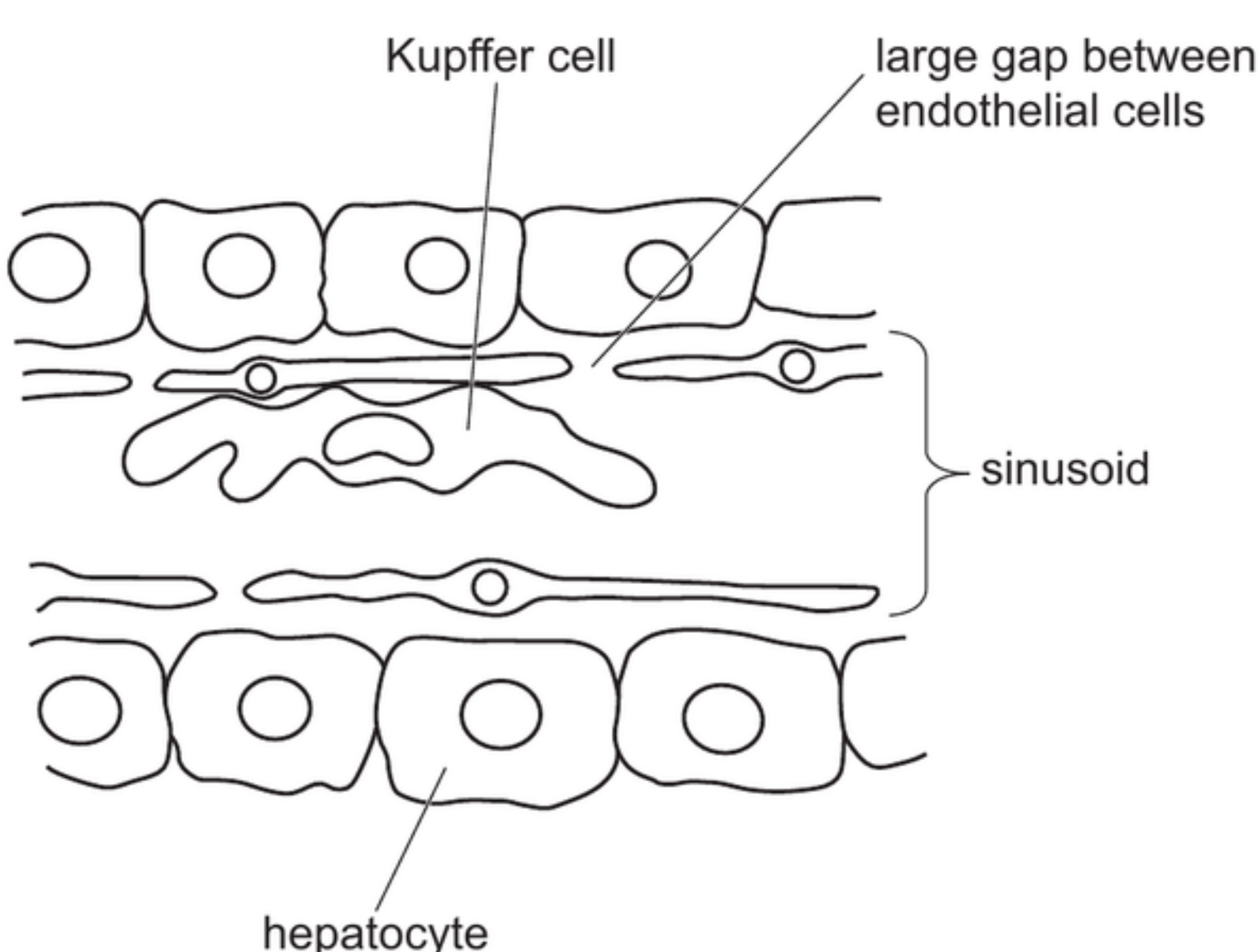


Fig. 3.1

(i) Suggest **one** advantage of having large gaps between the endothelial cells of the sinusoid, as shown in Fig. 3.1.

.....
.....
..... [1]

(ii) In addition to removing bacteria present in the blood inside the sinusoid, Kupffer cells are also able to remove old or damaged red blood cells.

Describe the mode of action of a Kupffer cell in removing and breaking down a damaged red blood cell.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [4]

(c) Fig. 3.2 is a transmission electron micrograph of part of a hepatocyte showing some cell structures.

The peroxisome shown in Fig. 3.2 is a spherical organelle bound by a single membrane. It carries out a variety of enzyme-catalysed metabolic reactions, including detoxification. Some of these reactions require oxygen.

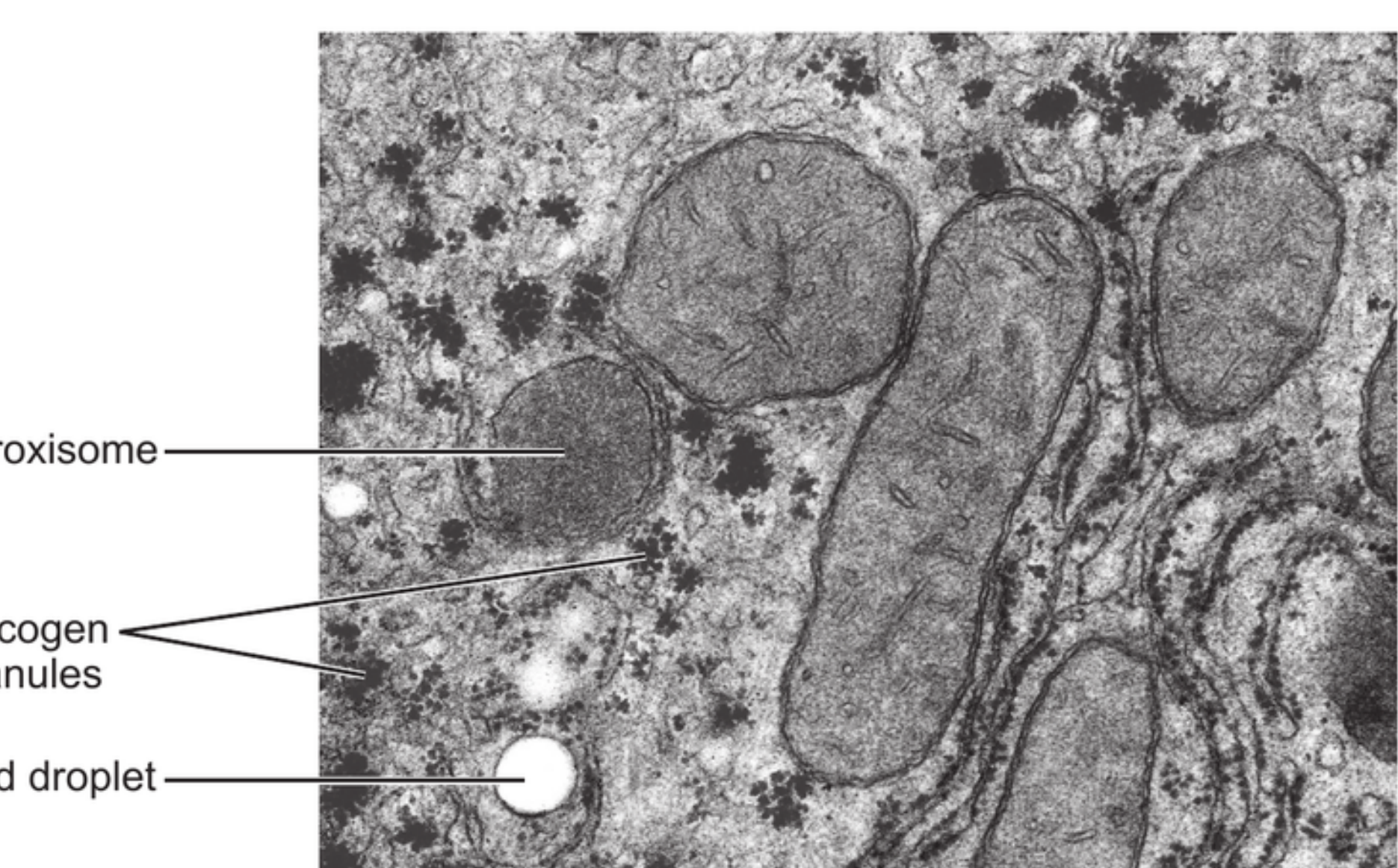


Fig. 3.2

(i) Describe the evidence **visible** in Fig. 3.2, apart from the presence of a peroxisome, that indicates some of the functions of a hepatocyte.

Add labels to Fig. 3.2 to identify the location of any cell structures, if not already labelled, that are part of your evidence.

.....
.....
.....
.....
.....

.....
.....
..... [3]

(ii) The mitochondria in Fig. 3.2 are larger than the peroxisome.

State **one other** difference, **visible** in Fig. 3.2, between a peroxisome and a mitochondrion.

.....
.....
.....
..... [1]

(iii) Some of the enzymes used within mitochondria can be synthesised by the organelle. Peroxisomes cannot synthesise any of the enzymes that they contain.

Suggest why a mitochondrion can synthesise enzymes, but a peroxisome cannot synthesise enzymes.

.....
.....
.....
.....
..... [2]

(iv) One of the enzymes present in peroxisomes is catalase. This enzyme catalyses the breakdown of hydrogen peroxide to harmless products.

Suggest why it is useful to the cell for this reaction to take place within peroxisomes.

.....
.....
.....
.....
..... [2]

Question No 23 - (9700_w23_23_4)

Subsection Topics: (a) : 6.2 - Protein synthesis | (b) : 6.1 - Structure of nucleic acids and replication of DNA, 6.2 - Protein synthesis | (c) : 1.2 - Cells as the basic units of living organisms, 1.1 - The microscope in cell studies | (d) : 4.2 - Movement into and out of cells

Fig. 4.1 is a diagram showing the transcription of part of the *COL1A2* gene that codes for a collagen polypeptide. The part of the *COL1A2* gene shown is a section of exon. Structure **A** represents an enzyme involved in transcription.

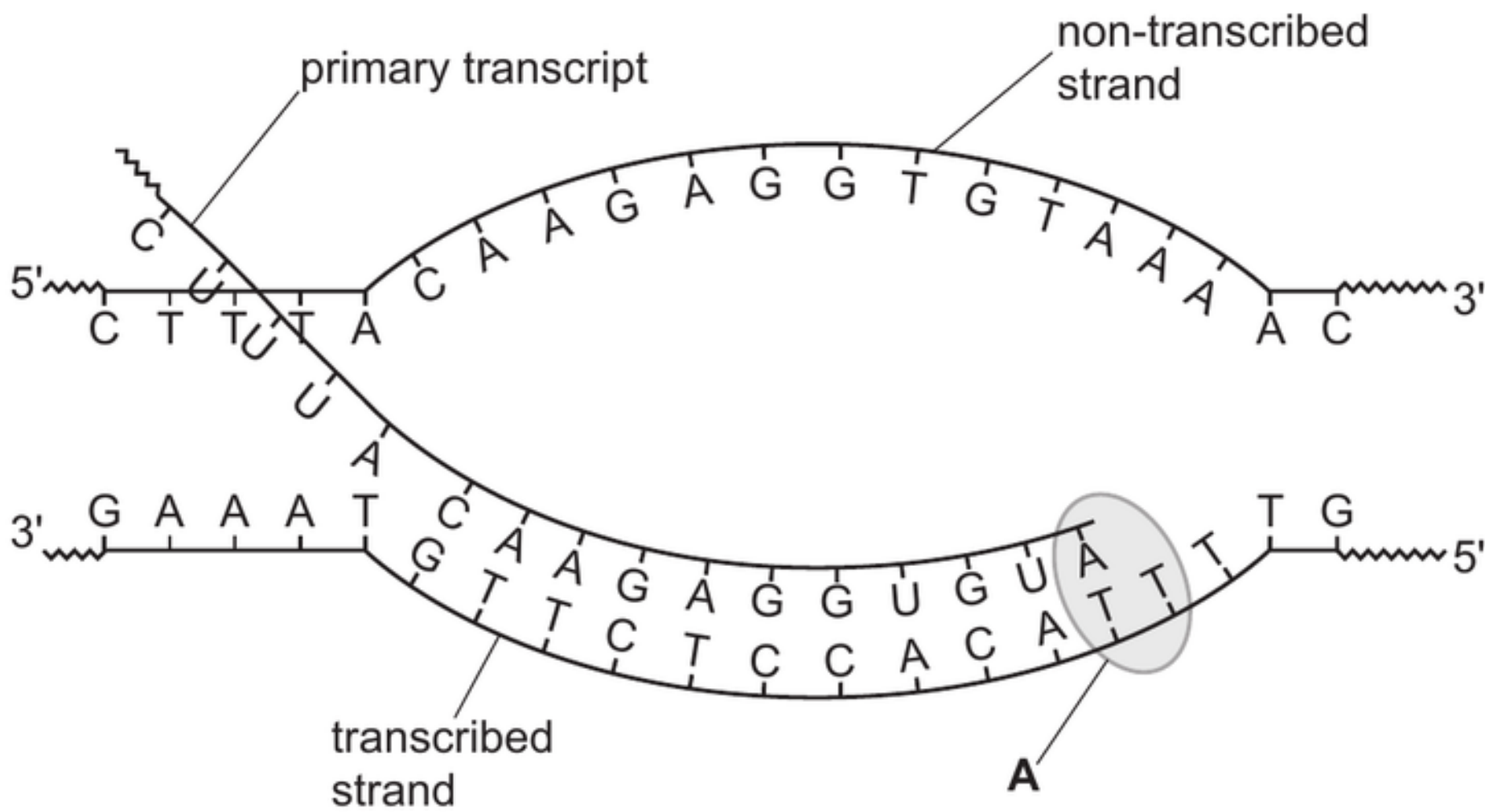


Fig. 4.1

- (a) (i) Name the enzyme labelled **A** in Fig. 4.1.
..... [1]
- (ii) Name the bond that forms between the nucleotides in the primary transcript.
..... [1]
- (b) (i) State the number of amino acids that are coded for by the sequence of nucleotides on the primary transcript shown in Fig. 4.1.
..... [1]
- (ii) Use the information in Fig. 4.1 to explain why one of the strands of DNA is **not** transcribed.
.....
.....
.....
.....
.....
..... [2]

- (c) New mitochondria are formed when a mitochondrion divides into two.

Fig. 4.2 is a transmission electron micrograph of a mitochondrion that is dividing.

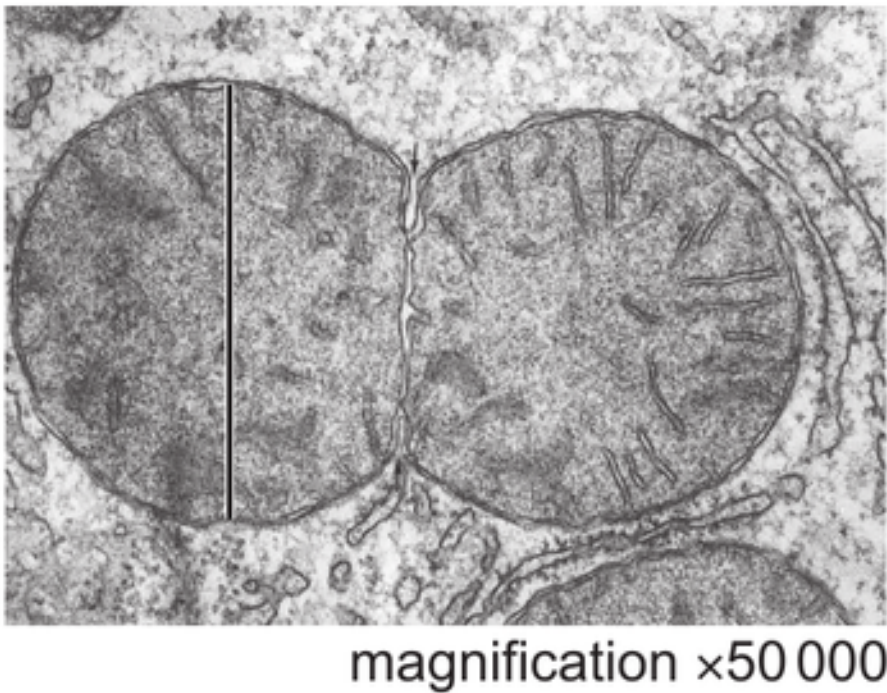


Fig. 4.2

- (i) State **two** features of mitochondria that are **visible** in Fig. 4.2.
- 1
2

[2]

(ii) The line on Fig. 4.2 shows the diameter of one of the mitochondria.

Calculate the actual diameter of the mitochondrion.

Give your answer to one significant figure.

answer = μm [1]

(d) Mitochondrial DNA codes for some polypeptides of proteins used within the mitochondrion. Some of the proteins allow movement of ions into and out of the mitochondria.

Outline the ways in which ions can move into mitochondria.

.....

.....

.....

.....

.....

..... [3]

Question No 24 - (9700_m22_22_4)

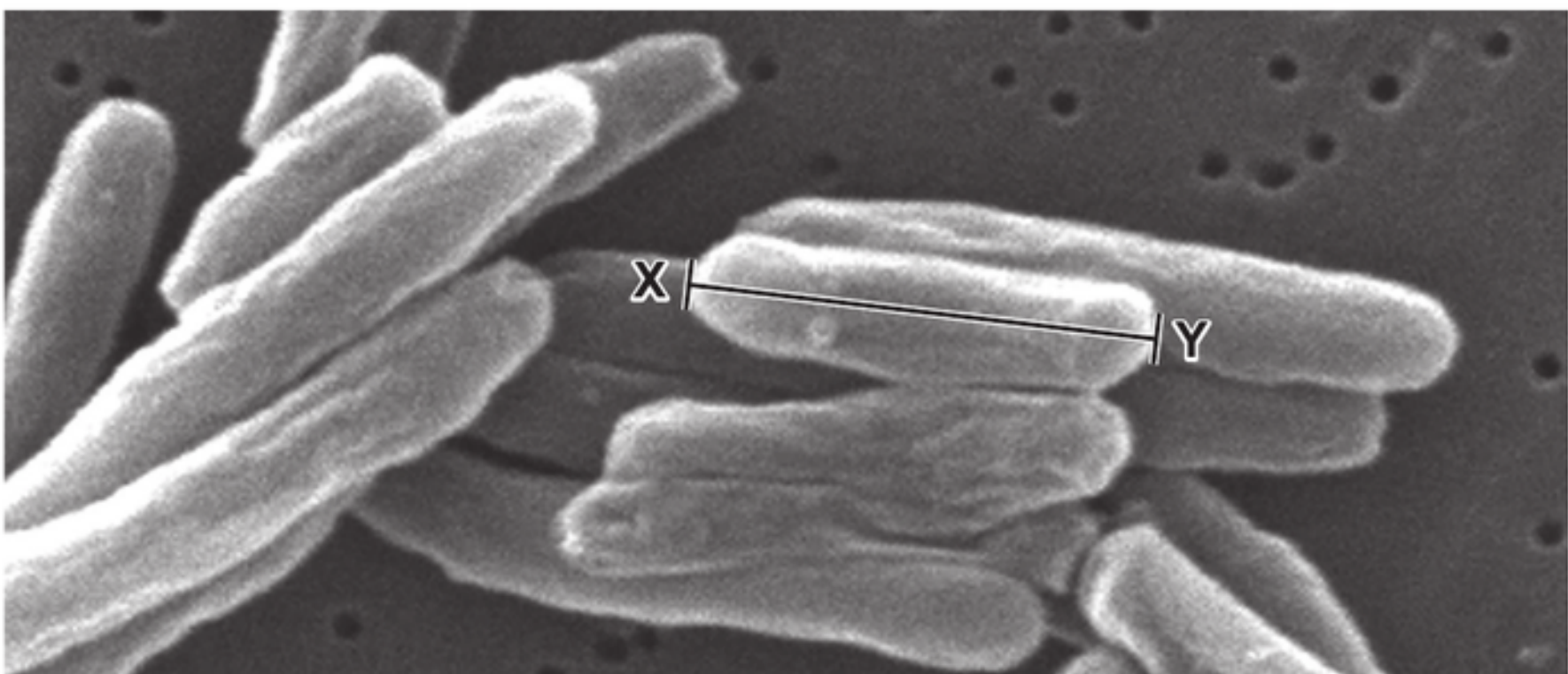
Subsection Topics: (a) : 10.1 - Infectious diseases | (b) : 1.1 - The microscope in cell studies | (c) : 1.2 - Cells as the basic units of living organisms | (d) : 10.1 - Infectious diseases | (e) : 11.1 - The immune system

Tuberculosis (TB) is a major cause of ill health worldwide.

(a) State the name of a bacterium that causes TB in humans.

..... [1]

(b) Fig. 4.1 is a scanning electron micrograph of bacteria that cause TB.



magnification $\times 21\,000$

Fig. 4.1

Calculate the actual length of the bacterial cell shown in Fig. 4.1, along the line X–Y.

Write the formula you will use in the box.

Give your answer in micrometres (μm) to two significant figures.

formula

actual length = μm
[2]

(c) Bacteria are unicellular prokaryotic cells with a diameter of 1–5 μm .

State **two other** structural features that would identify a cell as prokaryotic.

1

2 [2]

(d) The World Health Organization (WHO) Global Tuberculosis Report for 2019 published data on the estimated number of deaths from TB and HIV/AIDS in 2018. All deaths of people from TB who were infected with HIV were also counted as deaths of people with HIV/AIDS.

Fig. 4.2 shows these data. The dark grey boxes show the estimated number of deaths of people from TB who were also counted as deaths of people with HIV/AIDS.

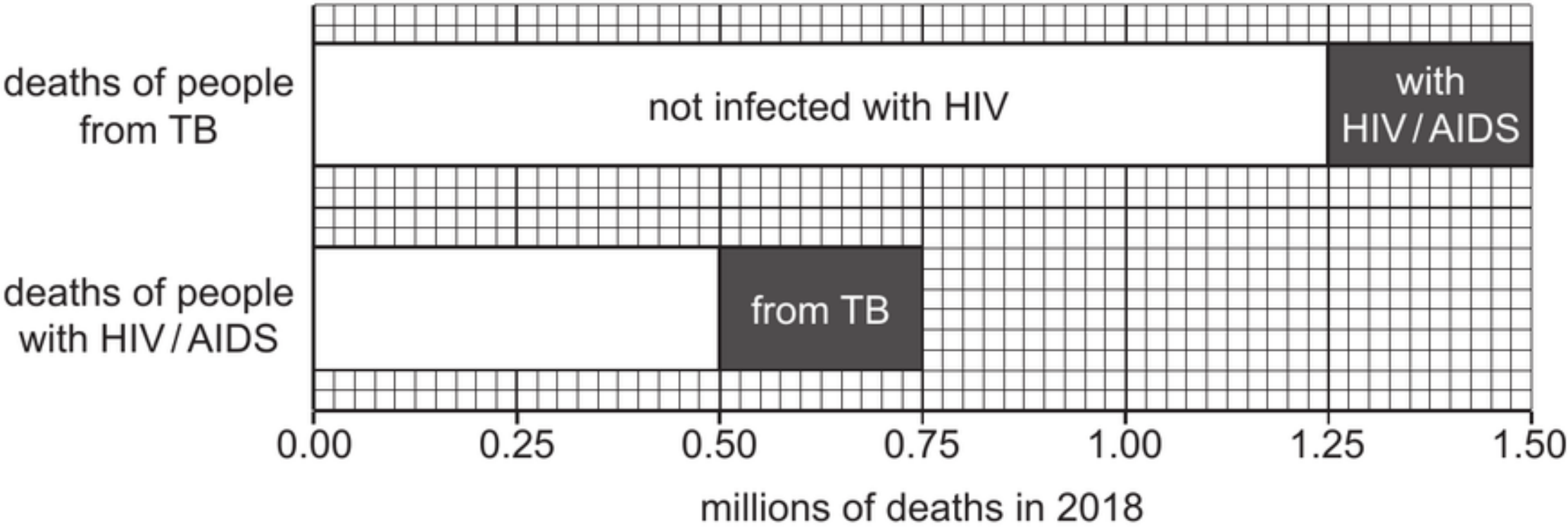


Fig. 4.2

A student used the data in Fig. 4.2 to predict that measures to control the spread of HIV will decrease the number of deaths from TB.

Discuss whether the data in Fig. 4.2 support this prediction.

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..... [3]

- (e) In healthy people, the number of T-helper cells ranges from 500 to 1200 cells per cm^3 of blood. In untreated people infected with HIV, the number of T-helper cells can decrease to below 200 cells per cm^3 of blood.

Explain how a low number of T-helper cells makes it more likely that untreated people infected with HIV will die if they are also infected with TB.

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..... [3]

Question No 25 - (9700_s22_21_1)
Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 9.1 - The gas exchange system | (c) : 8.2 - Transport of oxygen and carbon dioxide

Fig. 1.1 and Fig. 1.2 are photomicrographs showing the distribution of tissues in the lungs.

Fig. 1.1 is a photomicrograph of a section through part of the lungs.

Fig. 1.2 is a high-power view of the area indicated on Fig. 1.1.

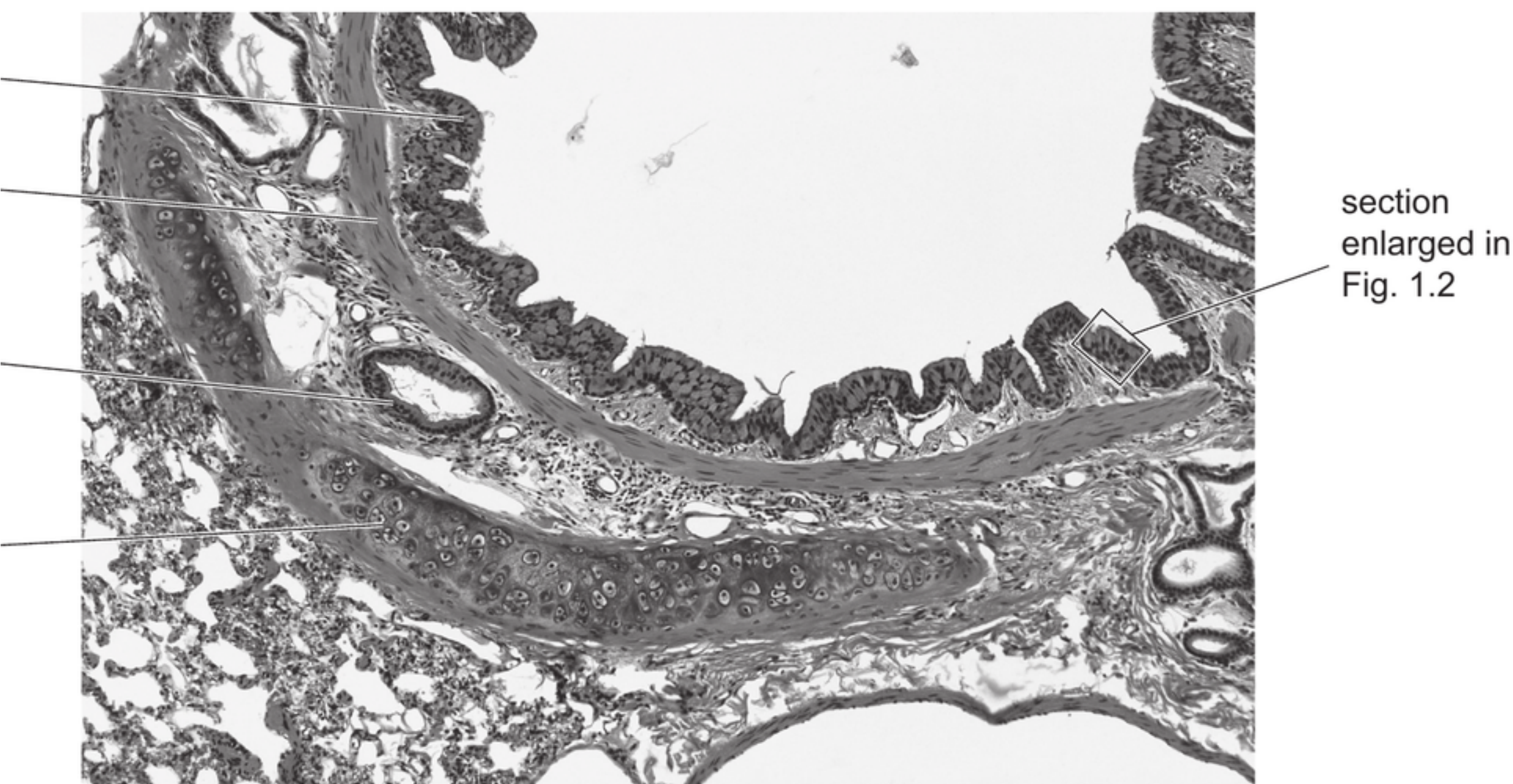


Fig. 1.1

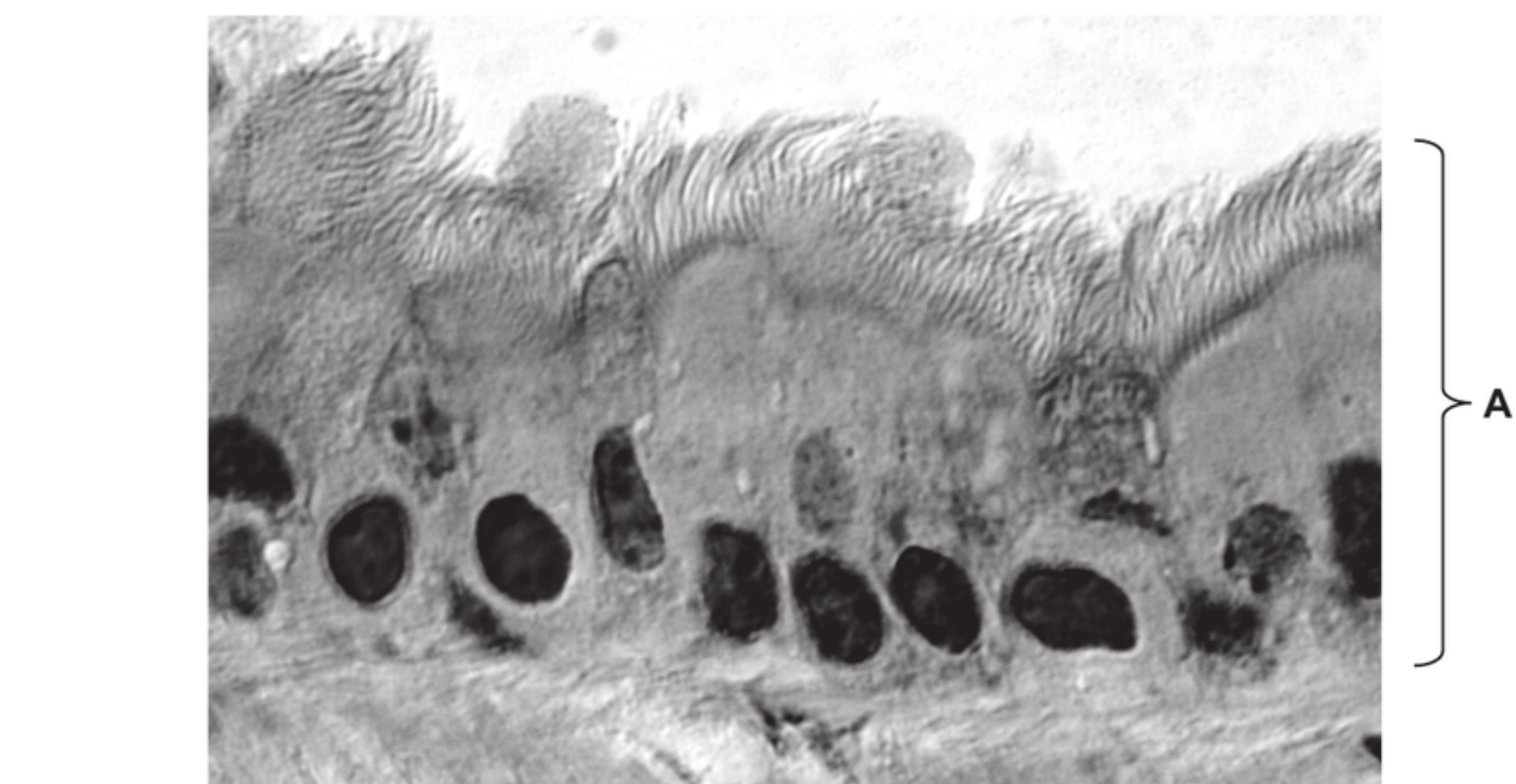


Fig. 1.2

- (a) State the names of the tissues **A**, **B** and **D**.
- A**
- B**
- D** [3]

- (b) Describe the role of the glands labelled **C** in Fig. 1.1 in maintaining the health of the gas exchange system.
-
-
-
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-
-
- [3]

- (c) Hyperventilation occurs when a person breathes too fast or too deeply.
- The effects of hyperventilation are:
- a decrease in the partial pressure of carbon dioxide in alveolar air
 - an increase in the pH of the blood.

Fig. 1.3 shows the change in the oxygen dissociation curve as a result of hyperventilation.

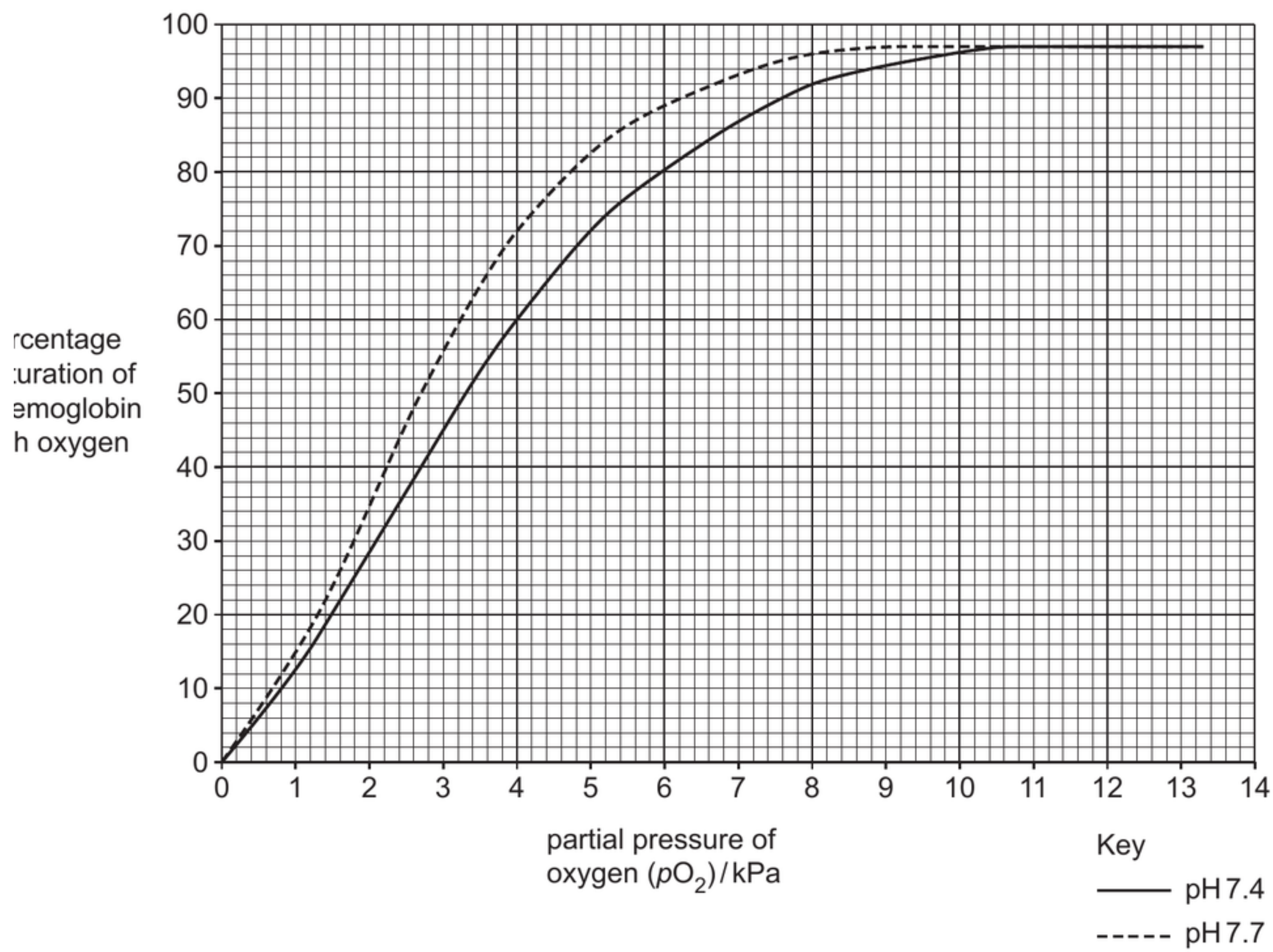


Fig. 1.3

(i) State the percentage saturation of haemoglobin at a pO_2 of 4.0 kPa.

pH = 7.7 kPa

pH = 7.4 kPa

[1]

(ii) Use the information in Fig. 1.3 to state **and** explain the effect of hyperventilation on the supply of oxygen to the respiring tissues.

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..... [2]

Question No 26 - (9700_s22_21_5)

Subsection Topics: (a) : 10.1 - Infectious diseases | (b) : 1.1 - The microscope in cell studies | (c) : 10.1 - Infectious diseases

(a) Infectious diseases are caused by pathogens and are described as transmissible diseases.

Explain what is meant by the term transmissible.

.....

..... [1]

(b) *Vibrio cholerae* is the bacterium that causes cholera.

Fig. 5.1 is a transmission electron micrograph of *V. cholerae*.

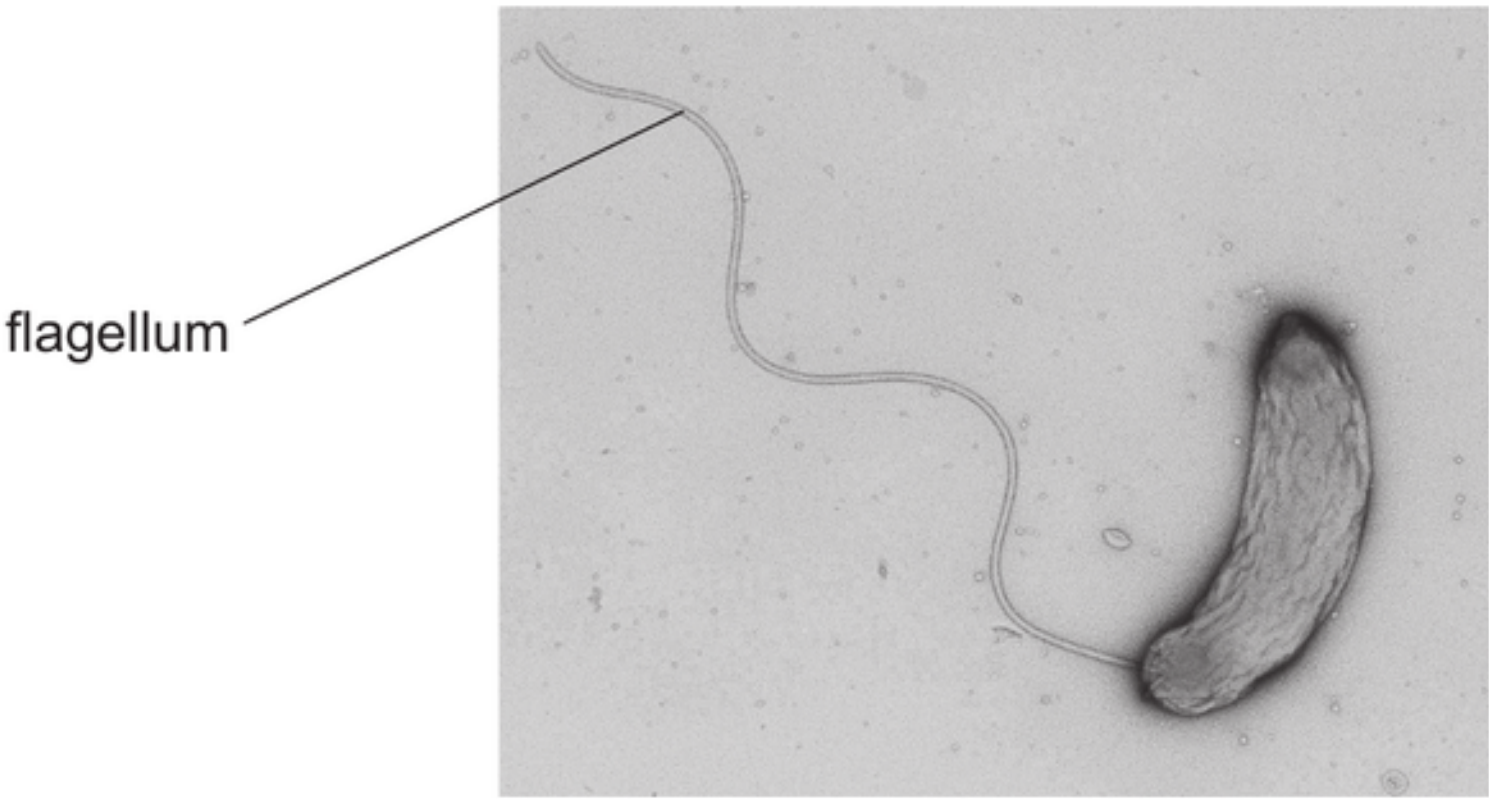


Fig. 5.1

A student wanted to know the actual length of the flagellum shown in Fig. 5.1.

State the information that is needed so that the student can calculate the actual length of the flagellum.

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..... [2]

(c) Table 5.1 shows data on large outbreaks of cholera that occurred in seven countries in 2019.

The case-fatality rate is the number of deaths as a percentage of the number of cases.

Table 5.1

country	number of cases of cholera	number of deaths from cholera	case-fatality rate /%
Cameroon	1 307	55	4.2
DR Congo	29 087	501	1.7
Haiti	684	3	0.4
Kenya	5 150	39	0.8
Somalia	9 968	50	0.5
Sudan	346	11	3.2
Yemen	2 260 195	2767	

Question No 27 - (9700_s22_21_2)

Subsection Topics: (a) : 11.1 - The immune system | (b) : 11.2 - Antibodies and vaccination | (c) : 11.1 - The immune system

B-lymphocytes are activated to form plasma cells during immune responses.

Fig. 2.1 is a drawing of a plasma cell made from a transmission electron micrograph.

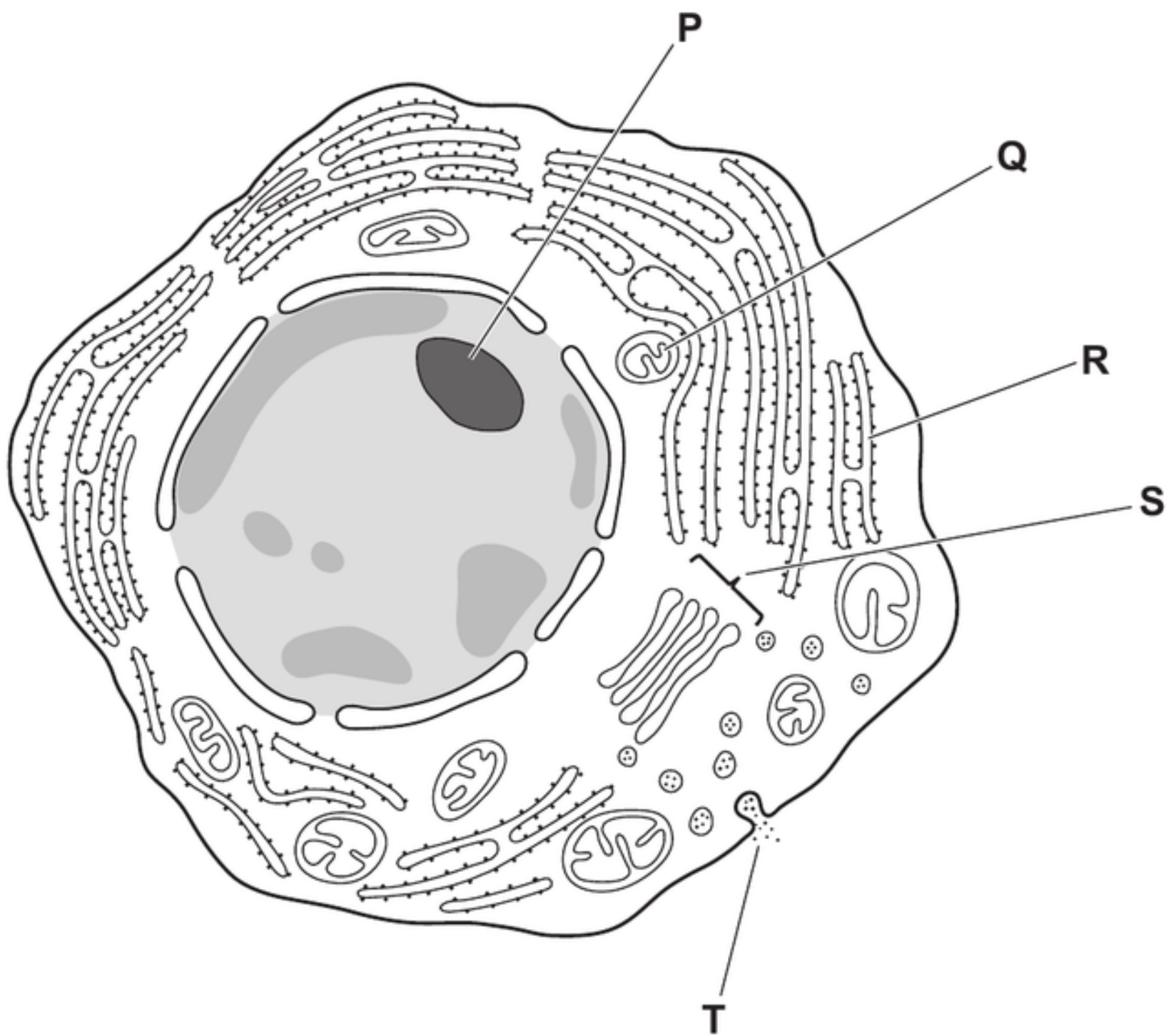


Fig. 2.1

- (a)

(i)

State the name of the process that is occurring at T.

..... [1]
- (ii)

Complete Table 2.1 to show the names and functions of the cell structures labelled P, Q, R and S in the plasma cell shown in Fig. 2.1.

Table 2.1

cell structure in Fig. 2.1	name of cell structure	function of cell structure in plasma cell
P		
Q		
R		
S		

[4]

(b) Plasma cells can be used in the commercial production of some monoclonal antibodies.

The method of production is known as the hybridoma method.

Outline the steps in the production of monoclonal antibodies by the hybridoma method.

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..... [3]

(c) Antibodies can be collected from human blood donors and used to treat people that may have been infected with a pathogen. This prevents them becoming ill with the disease.

Explain why this treatment does not prevent people becoming ill if they are infected again with the same pathogen.

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..... [4]

Question No 28 - (9700_s22_22_5)

Subsection Topics: (a) : 1.1 - The microscope in cell studies | (b) : 1.2 - Cells as the basic units of living organisms | (c) : 1.2 - Cells as the basic units of living organisms

Fig. 5.1 is a photomicrograph of a transverse section through part of the bronchus of the human gas exchange system. The image is of a good resolution for a light microscope.

The bronchial epithelium is a single layer of cells lining the lumen of the bronchus.

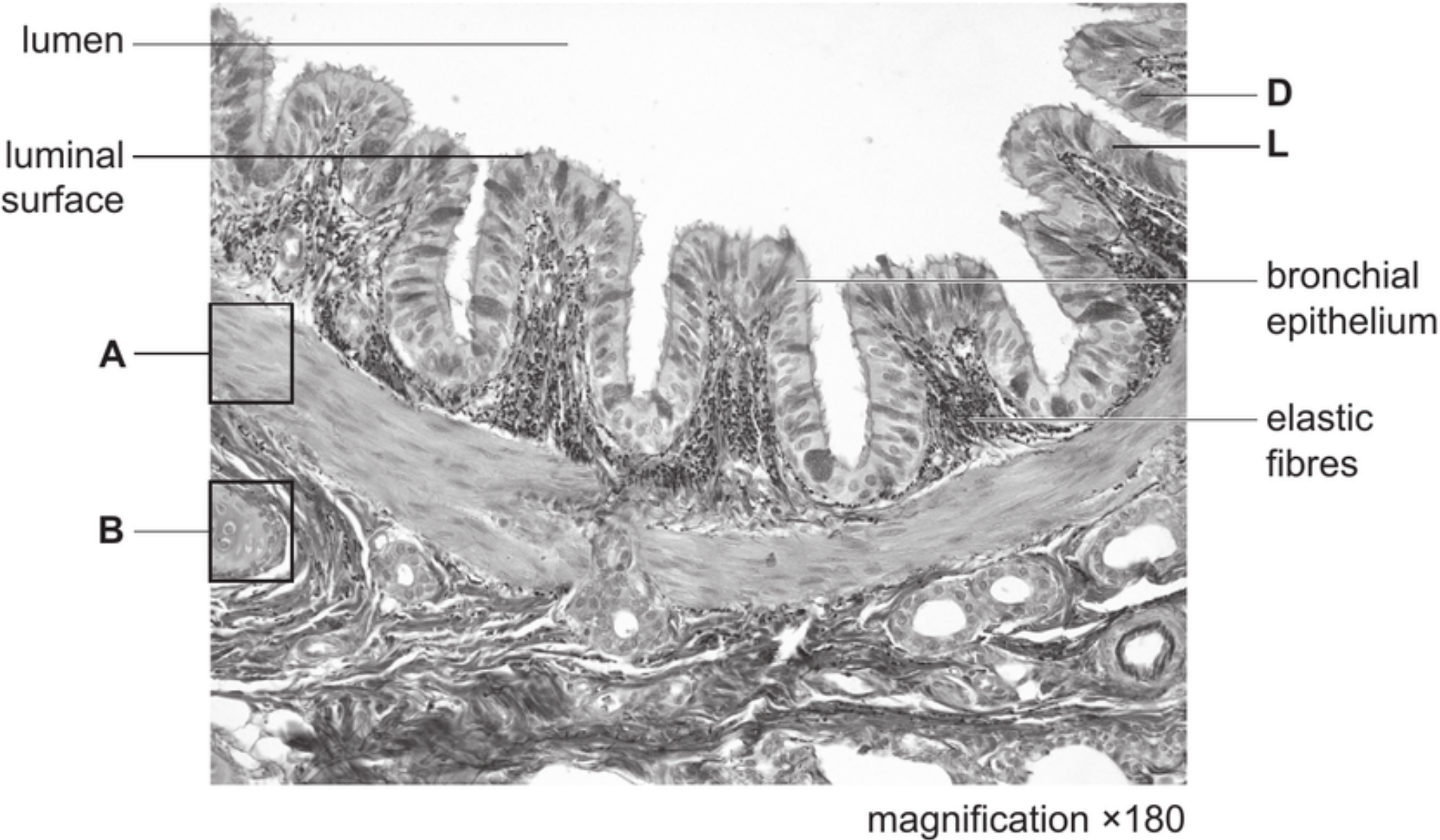


Fig. 5.1

- (a) The luminal surface shown in Fig. 5.1 is not clearly defined and appears slightly blurred.
- State why the luminal surface of the bronchial epithelium appears slightly blurred, even though the resolution of the image is good.
-
-
- [1]
- (b) Some cells of the bronchial epithelium shown in Fig. 5.1 appear darker than others. For example, cell **D** appears darker than cell **L**.
- With reference to the bronchial epithelium shown in Fig. 5.1, explain why some cells, such as cell **D**, appear darker and other cells, such as cell **L**, appear lighter.
-
-
-
-
- [2]

(c) In Fig. 5.1 the tissue in box **B** is cartilage.

The tissue shown in box **A** is different from the tissue in box **B**.

Outline the differences in the structure **and** function of tissue **A** compared with tissue **B**.

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..... [3]

Question No 29 - (9700_s22_22_1)
Subsection Topics: (a) : 1.1 - The microscope in cell studies | (b) : 1.1 - The microscope in cell studies |
(c) : 4.2 - Movement into and out of cells | (d) : 5.1 - Replication and division of nuclei and cells

Epithelial cells in the small intestine have cell structures known as microvilli. The microvilli of these cells are found only on the surface that borders the gut lumen.

Fig. 1.1 shows images of microvilli of intestinal epithelial cells. These images have been obtained using a scanning electron microscope and a transmission electron microscope.

Fig. 1.1**A** is at a different magnification to Fig. 1.1**B**.

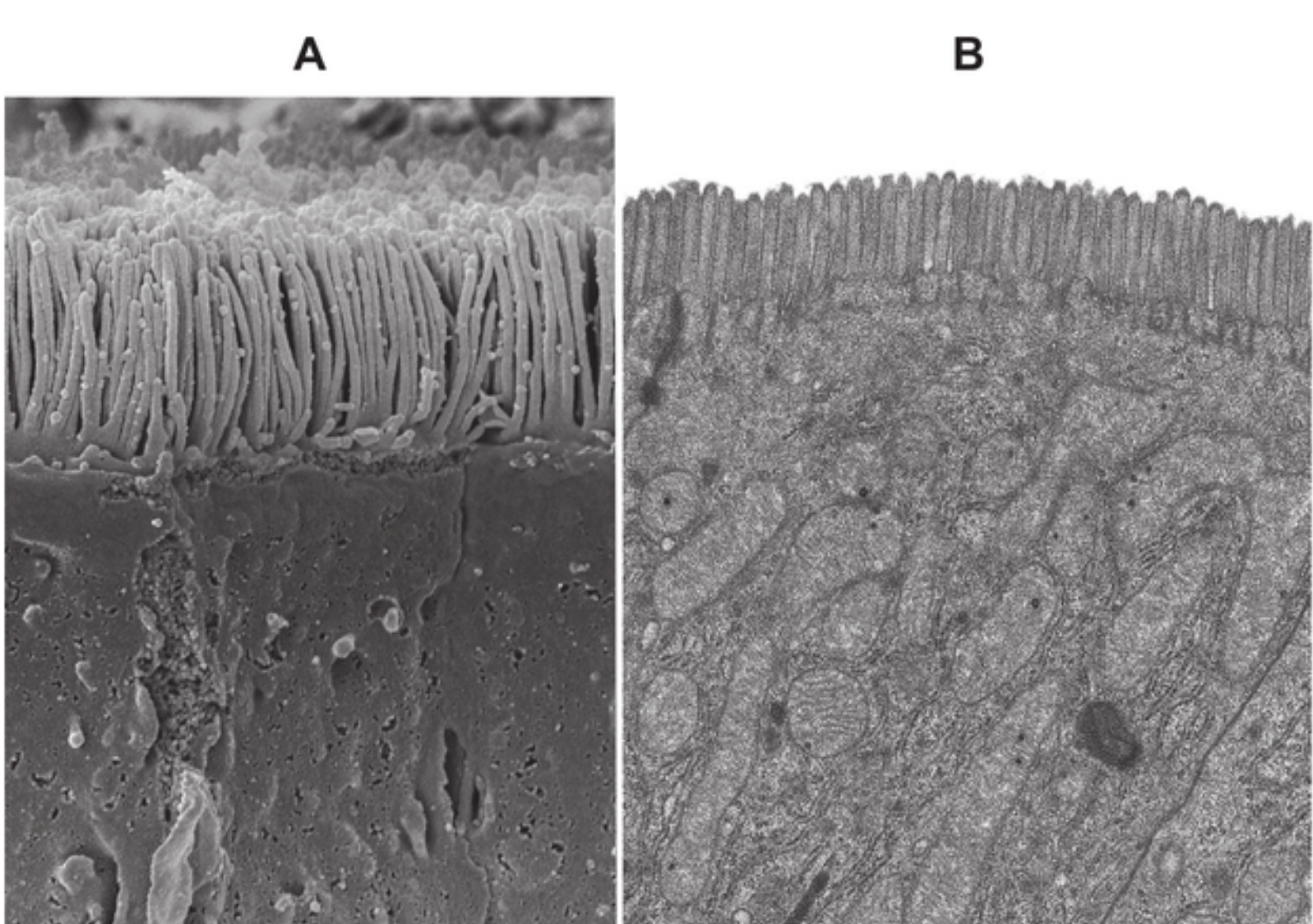


Fig. 1.1

(a) With reference to Fig. 1.1, state how it is possible to distinguish between a scanning electron micrograph and a transmission electron micrograph.

[1]

(b) The approximate length of a microvillus is 1 μm .

Outline the method you would use to estimate the magnifications of the images shown in Fig. 1.1.

[2]

(c) One role of an intestinal epithelial cell is the absorption of glucose from the gut lumen into the circulatory system. This involves different membrane transport proteins.

The events occurring in an intestinal epithelial cell during the absorption of glucose are summarised in Fig. 1.2.

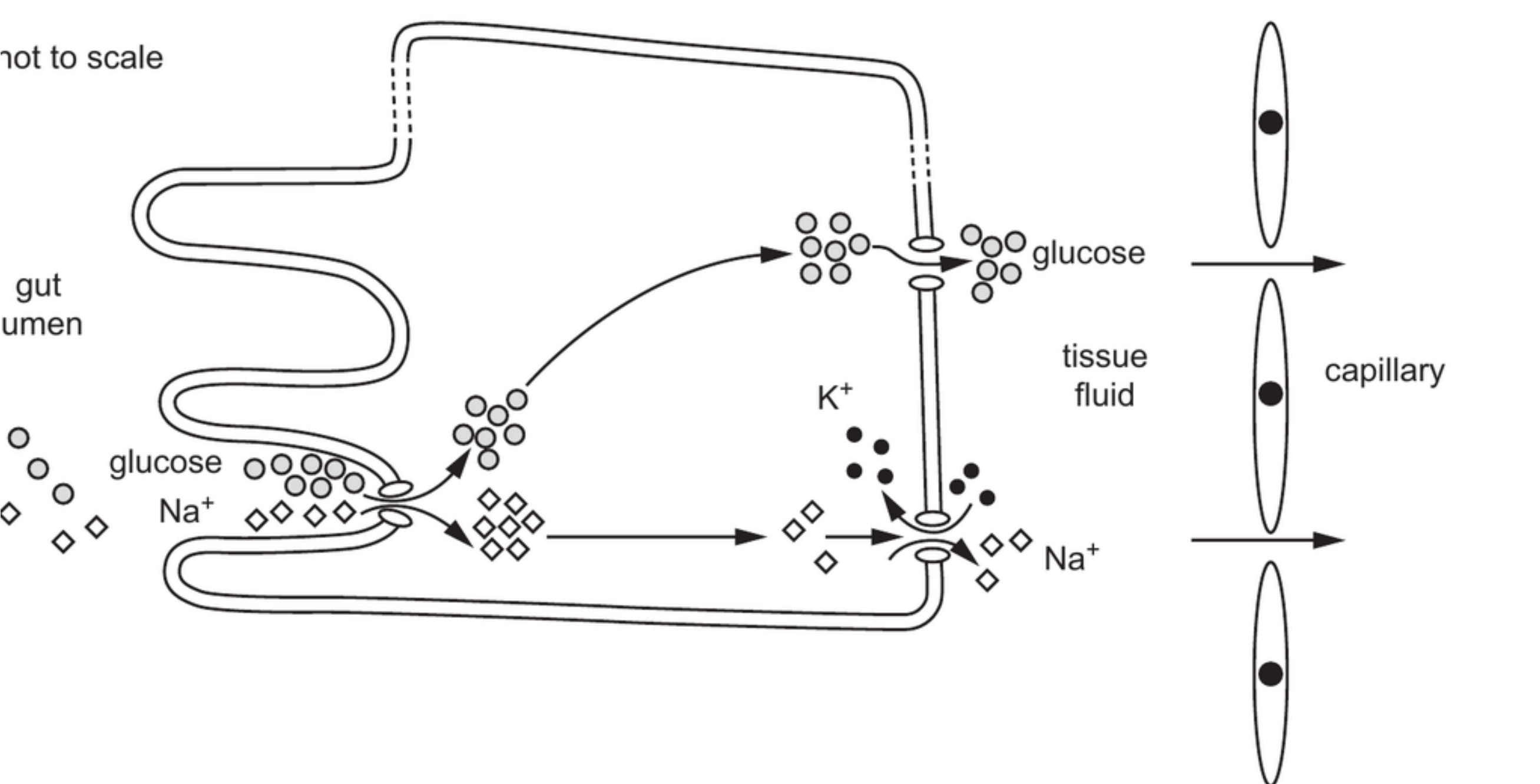


Fig. 1.2

- Sodium ions (Na^+) are removed from the cell by active transport through a transport protein known as a sodium-potassium (Na^+/K^+) pump.
 - This decreases the concentration of Na^+ in the cell compared to the gut lumen.
 - Glucose molecules are cotransported with Na^+ into the cell from the gut lumen.
 - Glucose molecules are transported out of the cell into the tissue fluid down a concentration gradient.
- (i)** Active transport involves water-soluble substances, such as Na^+ and K^+ , and the use of ATP to provide the energy needed for their transport through carrier proteins.

Outline **other** features of active transport.

(ii) Glucose molecules enter the cell through a membrane protein.

Suggest why glucose molecules need to be cotransported with Na^+ when it enters the cell through the membrane protein.

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..... [2]

(iii) Explain how microvilli increase the uptake of glucose into an intestinal epithelial cell.

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..... [2]

(d) Stem cells are also located in the wall of the small intestine. These cells divide by mitosis continuously.

Suggest **and** explain the importance of mitosis by stem cells in the small intestine.

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..... [4]

[Total: 13]

Question No 30 - (9700_s22_23_1)

Subsection Topics: (a) : 9.1 - The gas exchange system | (b) : 8.1 - The circulatory system | (c) : 1.2 - Cells as the basic units of living organisms

The trachea of the gas exchange system branches into two airways, each of which enters a lung.

(a) Name the airways that branch from the trachea to enter the lungs.
..... [1]

(b) The lower part of the trachea receives blood from arteries that branch from the aorta. Different arteries carry blood from the heart to the alveoli of the lungs.

State the differences between the arteries supplying the lower part of the trachea and the arteries that supply blood to the alveoli of the lungs.

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..... [2]

(c) Fig. 1.1 is a photomicrograph of a section through part of the trachea.

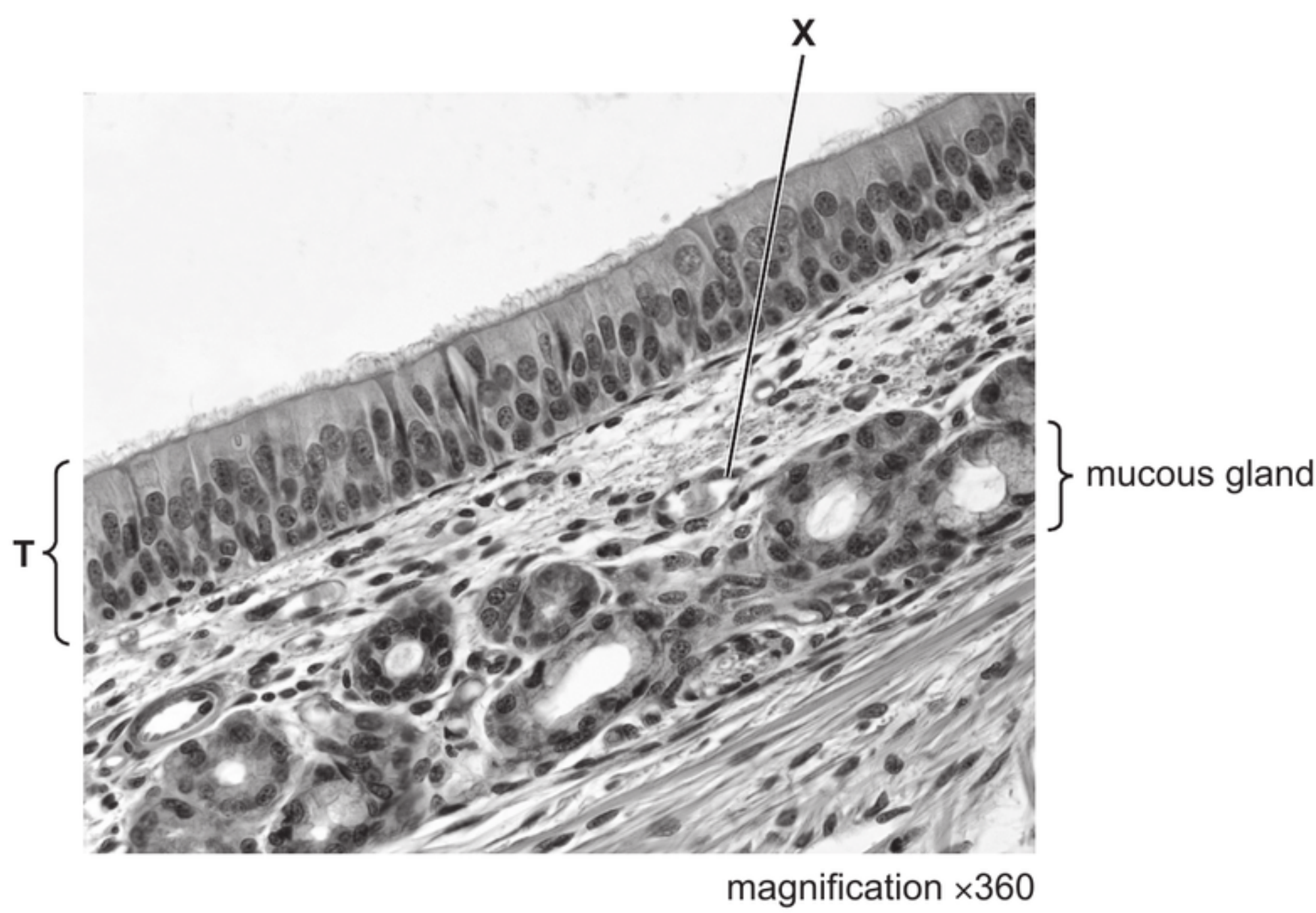


Fig. 1.1

(i) In Fig. 1.1, one of the tissues in the trachea is labelled T.

Describe the structural features of tissue T visible in Fig. 1.1.

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..... [3]

(ii) Identify structure **X** in Fig. 1.1 **and** outline the features that helped your identification.

structure **X** =
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..... [3]

Question No 31 - (9700_s22_23_4)
Subsection Topics: (a) : 1.1 - The microscope in cell studies | (b) : 10.1 - Infectious diseases | (c) : 10.1 - Infectious diseases | (d) : 6.1 - Structure of nucleic acids and replication of DNA | (e) : 11.2 - Antibodies and vaccination

There are many different forms of *Vibrio cholerae*, a bacterium that is found naturally in aquatic environments. The bacterium is motile (can move) and uses a cell structure known as a flagellum to allow it to move through water.

Fig. 4.1 is a drawing of four cells of one form of *V. cholerae*.

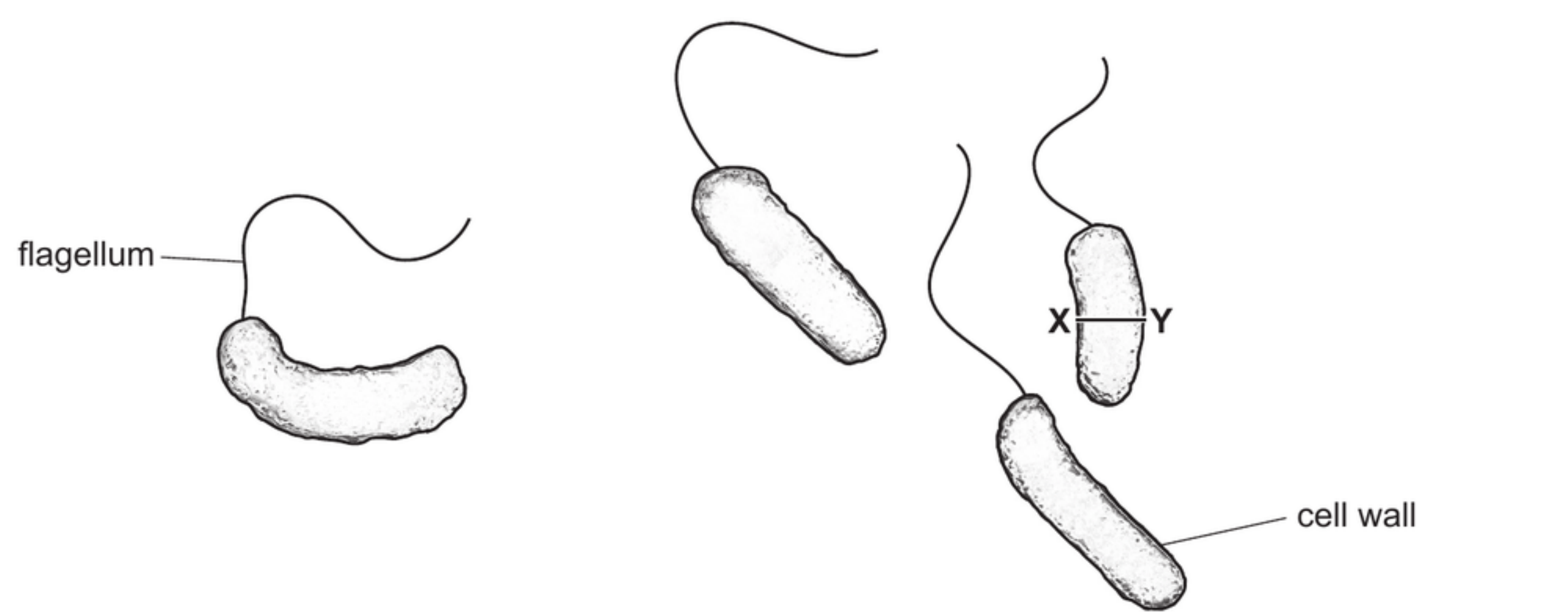


Fig. 4.1

Two main forms of *V. cholerae*, O1 and O139, are able to colonise the small intestine and cause cholera. These two forms are able to produce a toxin, cholera^{gen}, which causes the symptoms of diarrhoeal disease. Mutant *V. cholerae* that lack flagella are less able to cause disease.

(a) The magnification of the diagram shown in Fig. 4.1 is $\times 32\,000$.

Calculate the actual width **X–Y** in Fig. 4.1 in nanometres (nm) **and** give your answer to the nearest 10 nm.

Complete Fig. 4.2 to show the formula you will use to make your calculation.

actual width =

Fig. 4.2

answer = nm [2]

(b) State the term used to describe disease-causing organisms, such as the bacterium *V. cholerae*.

..... [1]

(c) Outline **one** way in which an uninfected person may become infected by *V. cholerae*.

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..... [1]

(d) Cholera^{gen} is produced after *V. cholerae* has penetrated (passed through) the mucus lining and attached to intestinal epithelial cells.

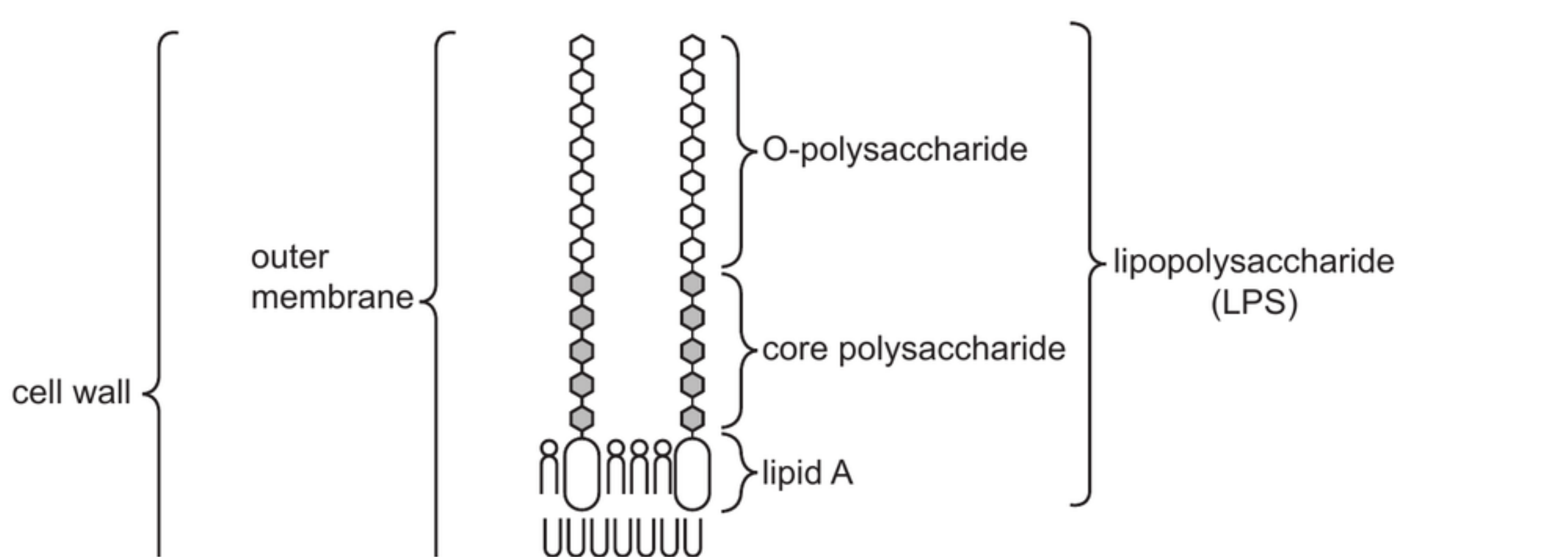
- Cholera^{gen} is composed of two subunits:
- subunit **A** consists of one polypeptide
 - subunit **B** consists of five identical polypeptides
 - the polypeptide in subunit **A** is different from the polypeptides in subunit **B**.

Two genes, *ctxA* and *ctxB*, are needed to produce cholera^{gen}. Only one strand of the DNA forming gene *ctxA* is involved in the production of subunit **A**. Only one strand of the DNA forming gene *ctxB* is involved in the production of subunit **B**.

Explain why only one strand of the DNA of each gene is involved in the production of the subunits.

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..... [3]

Monoclonal antibodies (mAbs) can be designed to act against components of the cell wall of *V. cholerae*. The cell wall has an outer membrane with lipopolysaccharide (LPS) molecules, shown in Fig. 4.3.



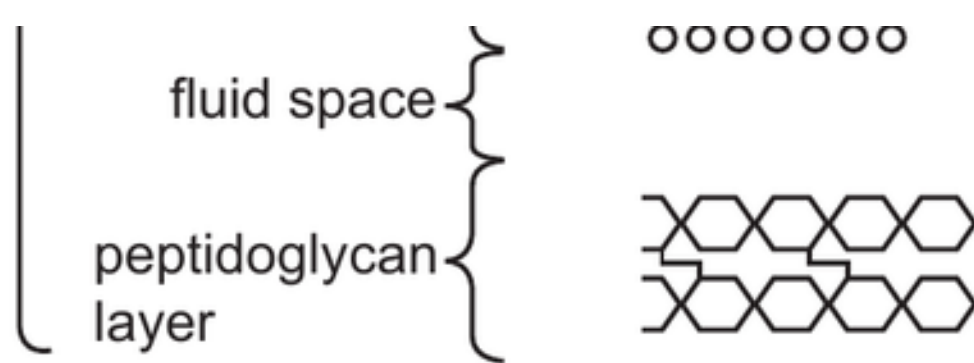


Fig. 4.3

The core polysaccharide and the lipid A components of the LPS molecules are the same in *V. cholerae* O1 and *V. cholerae* O139. However they have different O-polysaccharides.

There are also different types of *V. cholerae* O1 and these have different O-polysaccharides.

(e) Laboratory tests were carried out using two different monoclonal antibodies that had been designed and produced to act against the LPS of bacterial cultures of *V. cholerae* O1:

- mAb 2D6 acts against the O-polysaccharide
- mAb ZAC-3 acts against the core polysaccharide and lipid A components.

(i) Explain why the mAb ZAC-3 produced against the core polysaccharide and lipid A components will not act against the O-polysaccharide of the LPS molecules.

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..... [2]

(ii) The results of the tests showed that both mAbs were effective in causing agglutination (clumping) of bacteria and in preventing their motility. This suggests they may be useful for preventing cholera and for treating the disease.

Discuss whether mAb 2D6 and mAb ZAC-3 may be useful for preventing cholera **and** for treating the disease.

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..... [4]

Question No 32 - (9700_s22_23_2)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 4.2 - Movement into and out of cells | (c) : 2.2 - Carbohydrates and lipids | (d) : 1.2 - Cells as the basic units of living organisms

Bacterial cells are prokaryotic. The cells of plants are described as eukaryotic.

(a) Complete the passage comparing a bacterial cell with a plant cell.

A bacterial cell and a plant cell have a cell wall, but the main component of the bacterial cell wall is and not cellulose. The same organelle is used for protein synthesis in both cell types, but a bacterial cell only has smaller, 70S, A bacterial cell does not have a large surrounded by a tonoplast.

[3]

(b) Protoplasts are plant cells that have had their cell walls removed by treatment with enzymes. Scientists often use protoplasts when researching ways to improve the yield of crop plants.

Fig. 2.1 is a scanning electron micrograph of protoplasts of cells from the tobacco plant, *Nicotiana tabacum*.

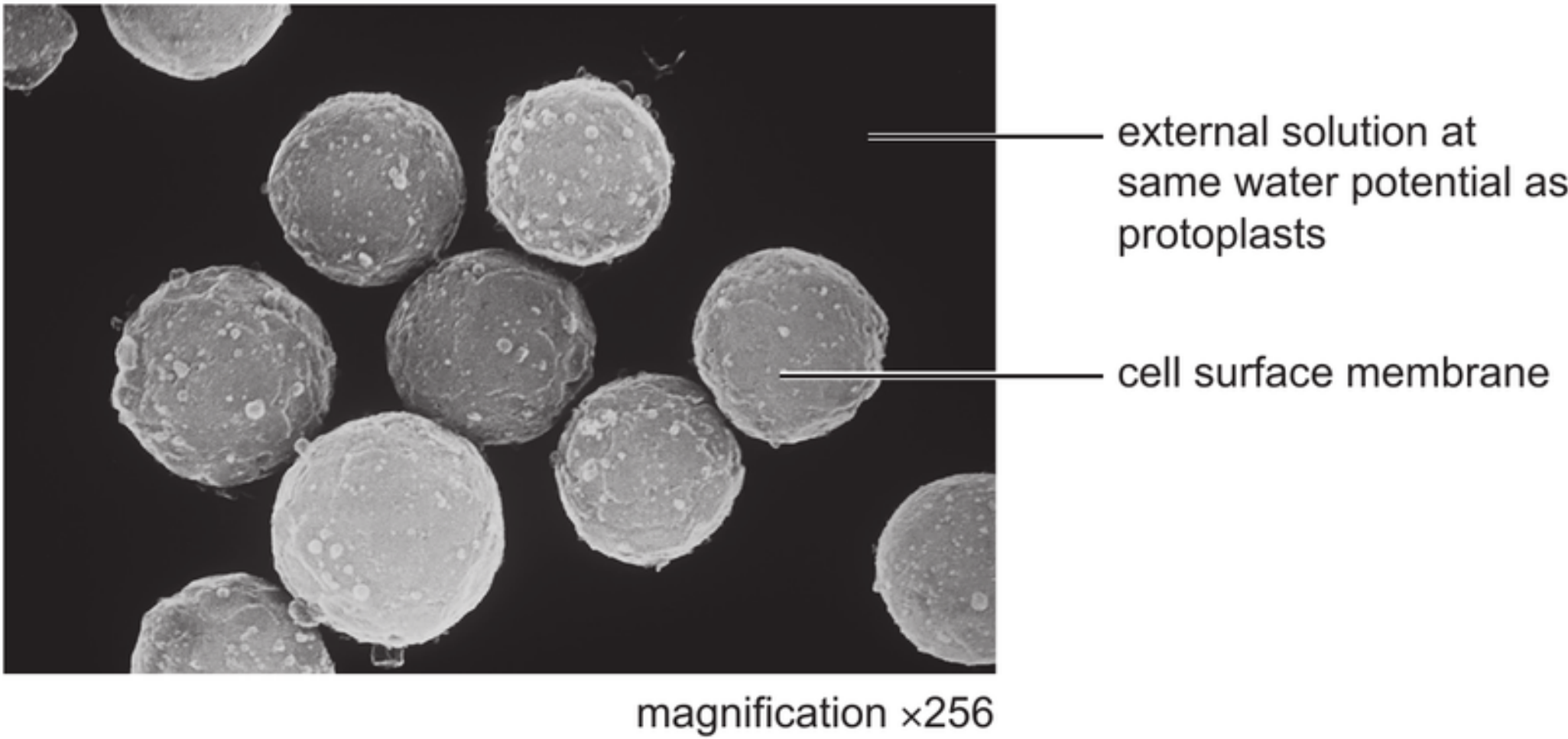


Fig. 2.1

Explain why scientists keep the protoplasts in a solution that has the same water potential as the cell.

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..... [2]

After protoplast treatment, the cells can be stimulated to synthesise new cell wall material.

Fig. 2.2 is at a higher magnification than Fig. 2.1 and shows a scanning electron micrograph of part of a protoplast in an early stage of cell wall synthesis.

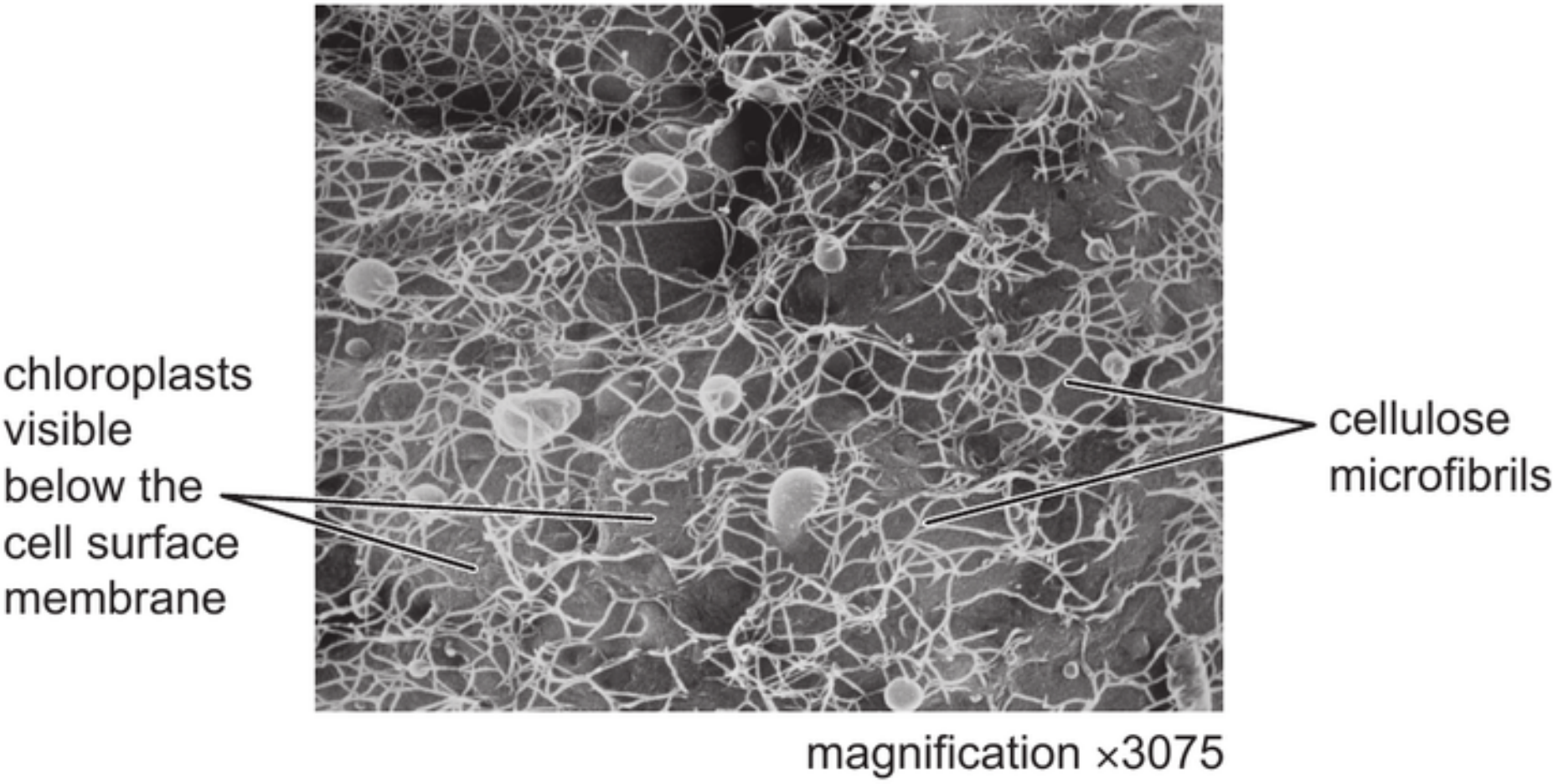


Fig. 2.2

(c) The cellulose microfibrils visible in Fig. 2.2 will form cellulose fibres. Each microfibril is formed

(c) The cellulose microfibrils visible in Fig. 2.2 will form cellulose fibres. Each microfibril is formed from cellulose molecules. Each cellulose molecule is a polymer of β -glucose.

(i) Describe the structure of a cellulose molecule **and** a cellulose microfibril.

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..... [3]

(ii) Name **one** substance that may be added to the network formed by the cellulose microfibrils in the formation of a cell wall.

..... [1]

(d) Name the type of plant cell that could have been used to produce the protoplast shown in Fig. 2.2.

..... [1]

[Total: 10]

Question No 33 - (9700_w22_21_1)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 1.1 - The microscope in cell studies

(a) Fig. 1.1 is a transmission electron micrograph showing a section of a human liver cell.

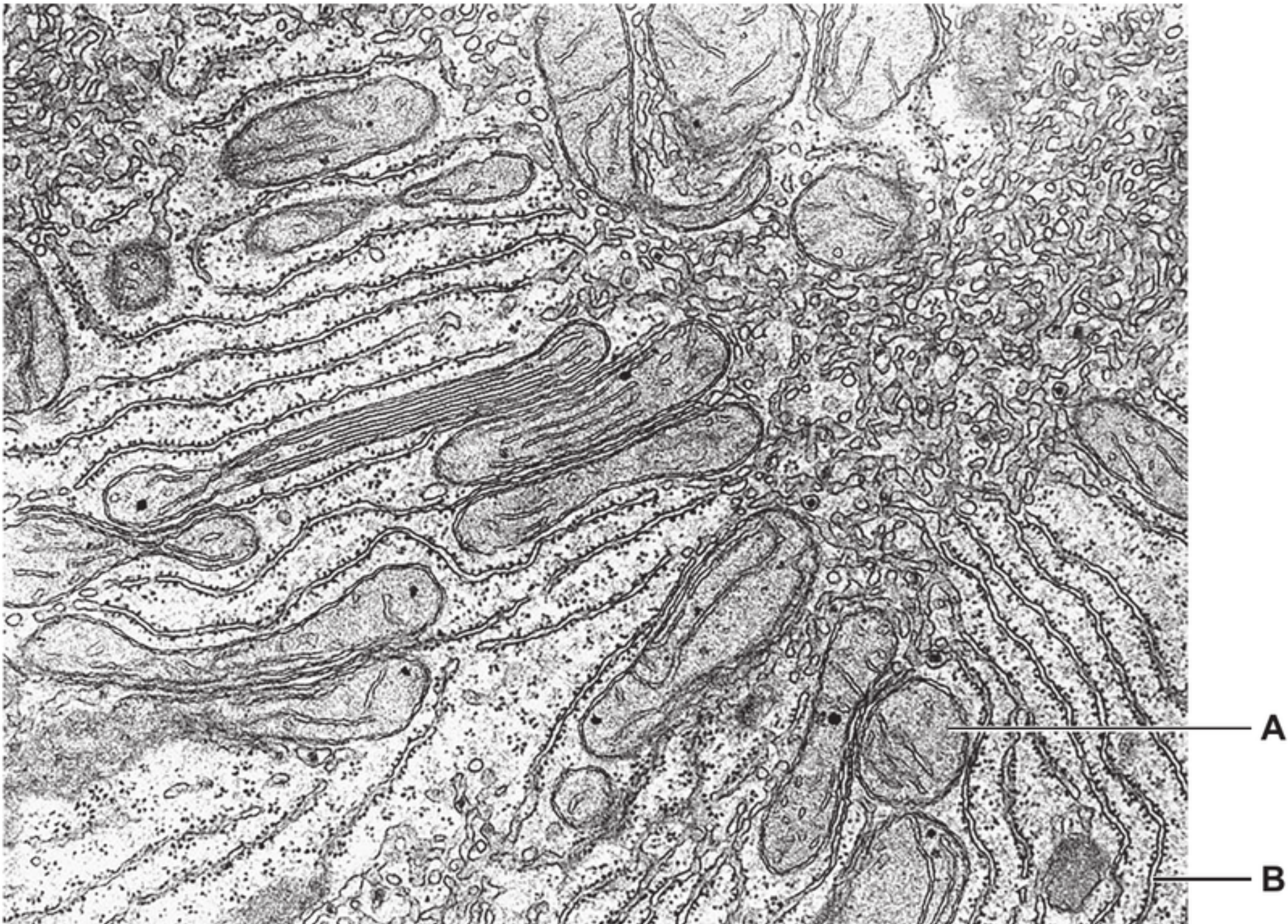


Fig. 1.1

(i) Name organelles **A** and **B** shown in Fig. 1.1.

A

B [2]

(ii) In liver cells, enzymes are attached to the membrane of smooth endoplasmic reticulum.

With reference to the functions of smooth endoplasmic reticulum, suggest the advantages of having enzymes attached to the membrane rather than free in the lumen.

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..... [3]

(b) Explain the advantages of using a transmission electron microscope compared with a light microscope when viewing a liver cell.

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..... [3]

[Total: 8]

Question No 34 - (9700_w22_21_5)
Subsection Topics: (a) : 7.2 - Transport mechanisms | (b) : 7.1 - Structure of transport tissues | (c) : 1.2 - Cells as the basic units of living organisms | (d) : 10.1 - Infectious diseases

- (a) When water molecules enter a plant through the roots, the molecules cross the cortex and enter the xylem tissue to be transported to other parts of the plant.

There are two pathways that water can take when crossing the root to the xylem tissue.

Complete Table 5.1 with information about the two pathways.

Table 5.1

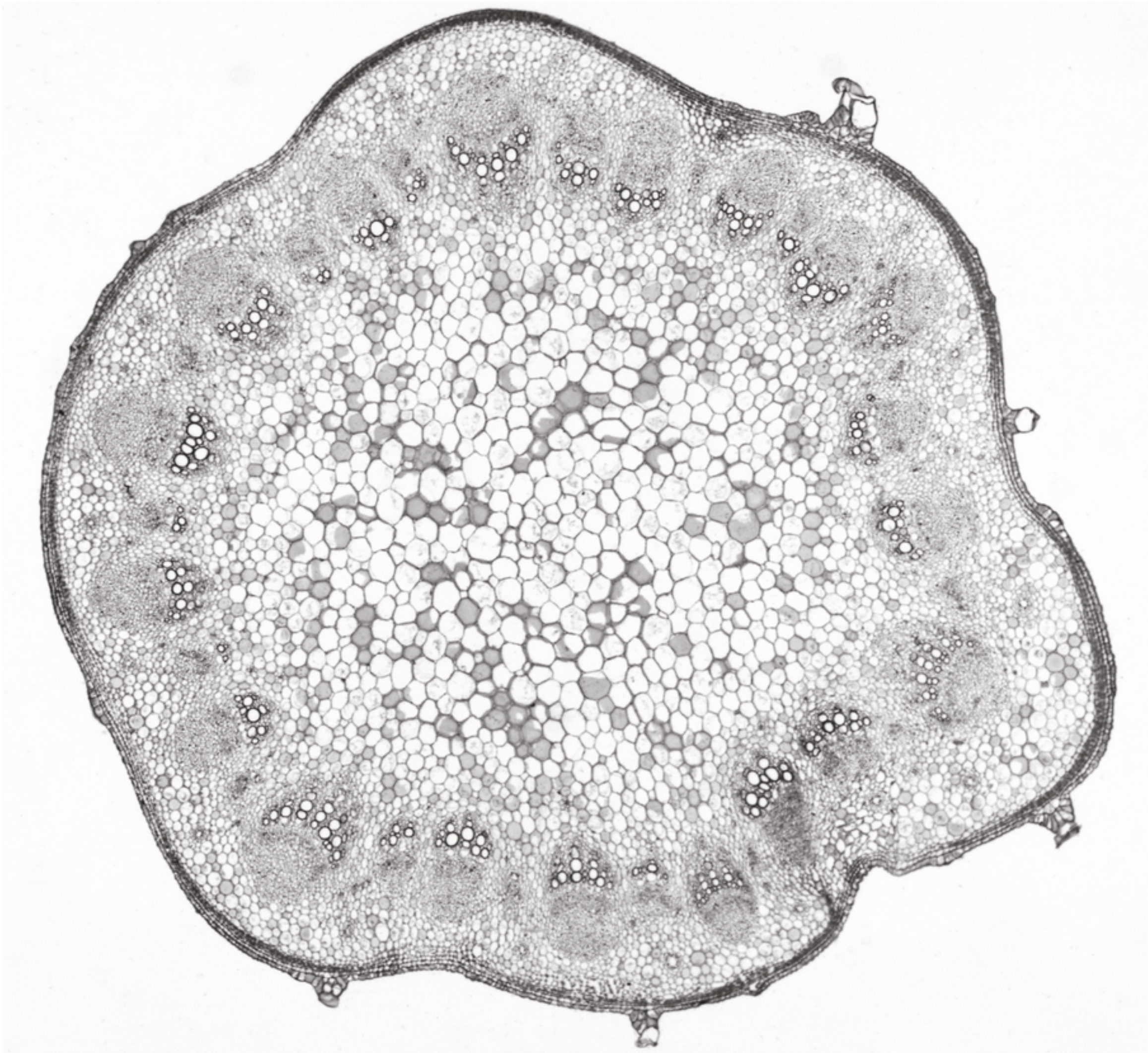
name of pathway	outline of pathway
	movement of water from cell to cell through plasmodesmata

[2]

- (b) Fig. 5.1 is a photomicrograph of a transverse section through the stem of a flowering plant.

On Fig. 5.1, draw a label line and the letter **T** to identify xylem tissue.

[1]



- (c) Scientists have studied the process of cell death that occurs during the development of the cells that become mature xylem vessel elements.

During this development, the tonoplast ruptures (bursts) and releases hydrolytic enzymes contained in the vacuole into the cytoplasm.

- (i) Name an organelle found in animal cells that has a similar function to the vacuole in the developing xylem vessel elements.

..... [1]

- (ii) The rupture of the tonoplast during development of xylem vessel elements is due to changes in permeability of the tonoplast.

Suggest how the permeability of the tonoplast changes **and** explain how this change could result in the rupture of the tonoplast.

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..... [3]

- (iii) During development of the xylem vessel elements the pH of the cytoplasm decreases. This change in pH activates enzymes in the cytoplasm that cause organelles to swell.

Suggest how a change in pH of the cytoplasm can activate enzymes.

.....

.....

.....

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..... [2]

(d) Some insects are vectors of disease.

- (i) When an insect feeds on the xylem fluid it can act as a vector of plant diseases such as Pierce’s disease. This bacterial disease affects many fruit trees causing the leaves to turn brown and drop from the plant, resulting in much less fruit being produced.

Explain why Pierce’s disease can be described as an infectious disease.

.....

.....

.....

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..... [2]

- (ii) Malaria is another infectious disease that also involves an insect vector.

State the type of organism that causes malaria **and** name **one** organism that causes malaria in humans.

type of organism

name [2]

Question No 35 - (9700_w22_22_2)

Subsection Topics: (a) : 6.1 - Structure of nucleic acids and replication of DNA | (b) : 1.1 - The microscope in cell studies | (c) : 6.1 - Structure of nucleic acids and replication of DNA | (d) : 1.2 - Cells as the basic units of living organisms | (e) : 6.1 - Structure of nucleic acids and replication of DNA | (f) : 5.1 - Replication and division of nuclei and cells | (g) : 11.1 - The immune system

Human cytomegalovirus (HCMV) is a common virus affecting humans. In people with a fully functioning immune system, infection by HCMV usually causes no, or only mild, symptoms.

Fig. 2.1**A** is a diagram of a section through HCMV. In Fig. 2.1**B**, only the outer part of HCMV is sectioned.

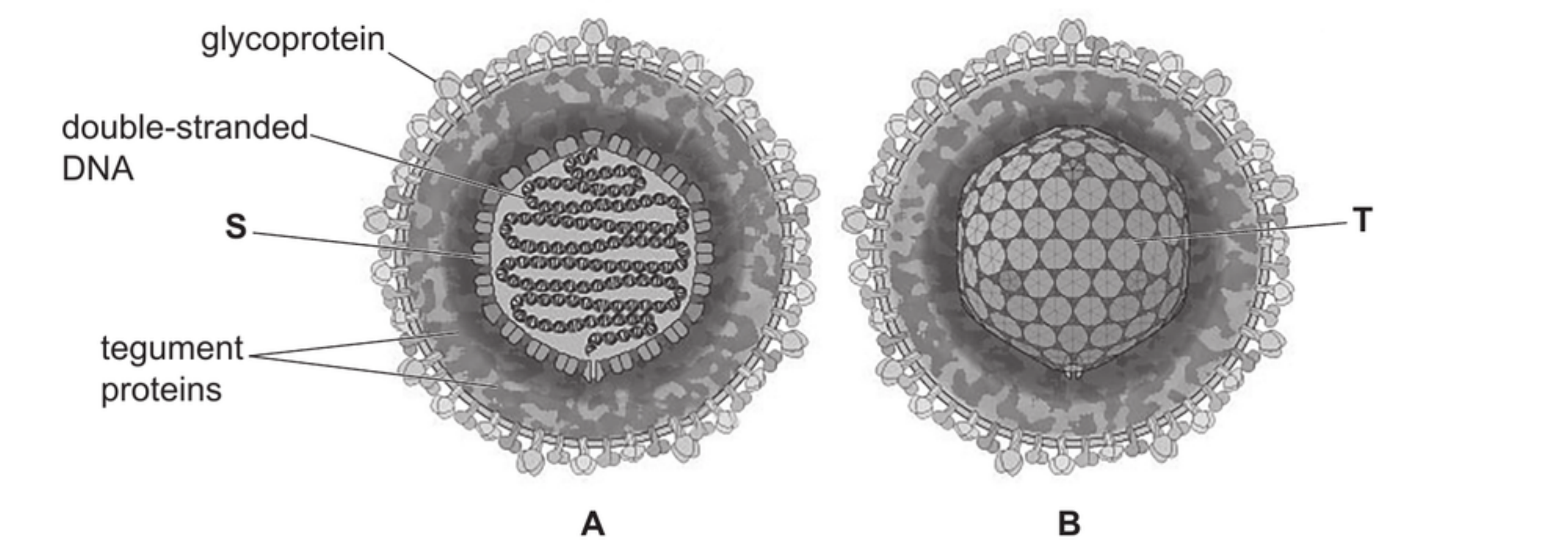


Fig. 2.1

The viral DNA shown in Fig. 2.1 contains genes that code for proteins important in viral replication and viral structure, including viral DNA polymerase and proteins known as tegument proteins.

Viruses can only replicate in host cells as they need to use processes and contents of the host cell. Complete viral particles that are released from the host cell are known as virions.

(a) Structure **S** in Fig. 2.1**A** is a subunit of structure **T** in Fig. 2.1**B**.

Name the chemical compound used to make structure **S** and name structure **T**.

S

T

[2]

(b) The actual diameter of the HCMV shown in Fig. 2.1 is 0.17 micrometres (µm).

Calculate the actual diameter of the virus in nanometres (nm).

..... [1]

(c) Suggest the role of viral DNA polymerase within the host cell.

..... [1]

(d) The virus in Fig. 2.1 is drawn as a spherical shape. Structure **T** is always the same shape. However, electron micrographs show that HCMV virions are not all the same shape.

Suggest how HCMV virions can be of different shapes.

.....
.....
.....
.....
..... [2]

(e) With reference to Fig. 2.1**A**, state **one** similarity **and** **one** difference between the genetic material of HCMV and the genetic material of a typical bacterial cell.

.....
.....
.....
..... [2]

(f) HCMV is known to infect some types of human cell that carry out the mitotic cell cycle.

Studies have shown that in the presence of one tegument protein, UL69, the cell cycle stops in the G1 stage.

Outline the effects the presence of UL69 will have on the normal activity of the mitotic cell cycle.

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..... [3]

(g) After a person has been infected with HCMV, the virus remains in a dormant state in the body for life.

If the virus becomes active again (reactivates), the virus will only cause serious illness if the person has a weak immune system at that time.

Explain why the response to reactivation of HCMV is more likely to cause serious illness in a person who has a weak immune system.

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..... [4]

Question No 36 - (9700_w22_23_1)

Subsection Topics: (a) : 2.3 - Proteins, 1.2 - Cells as the basic units of living organisms | (b) : 2.3 - Proteins | (c) :

(a) During translation, a polypeptide is synthesised when amino acids are added to a growing chain of amino acids.

Fig. 1.1 shows part of a growing chain of amino acids and the amino acid cysteine.

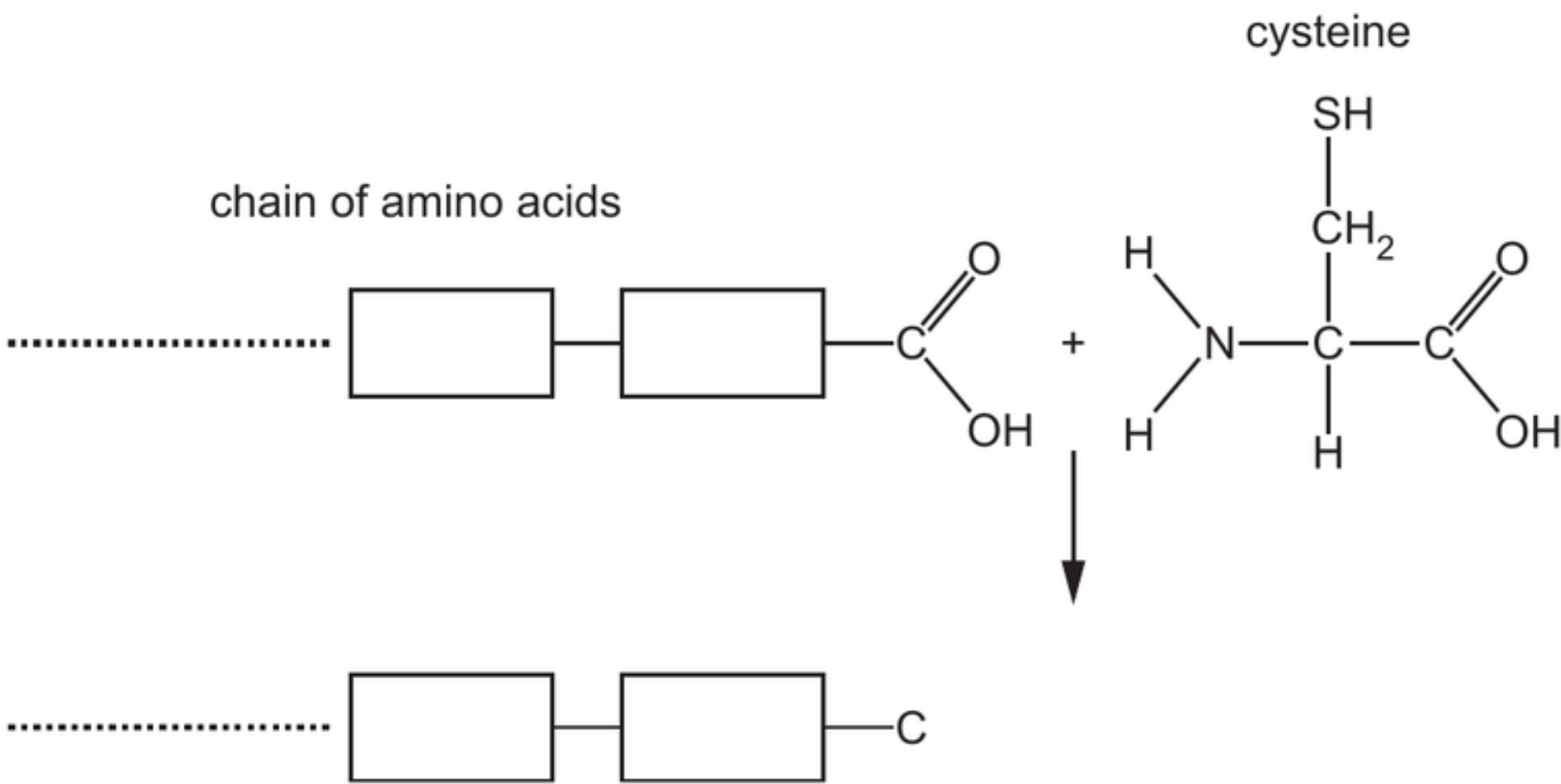


Fig. 1.1

(i) Complete Fig. 1.1 by showing the formation of the bond between cysteine and the growing chain of amino acids in the process of translation. [3]

(ii) State the name of the covalent bond that forms when cysteine is added to the growing chain of amino acids. [1]

(iii) State the organelle where the reaction shown in Fig. 1.1 takes place. [1]

(b) Fig. 1.2 is a ribbon diagram showing the three-dimensional structure of a protein from the bacterium *Streptococcus*.

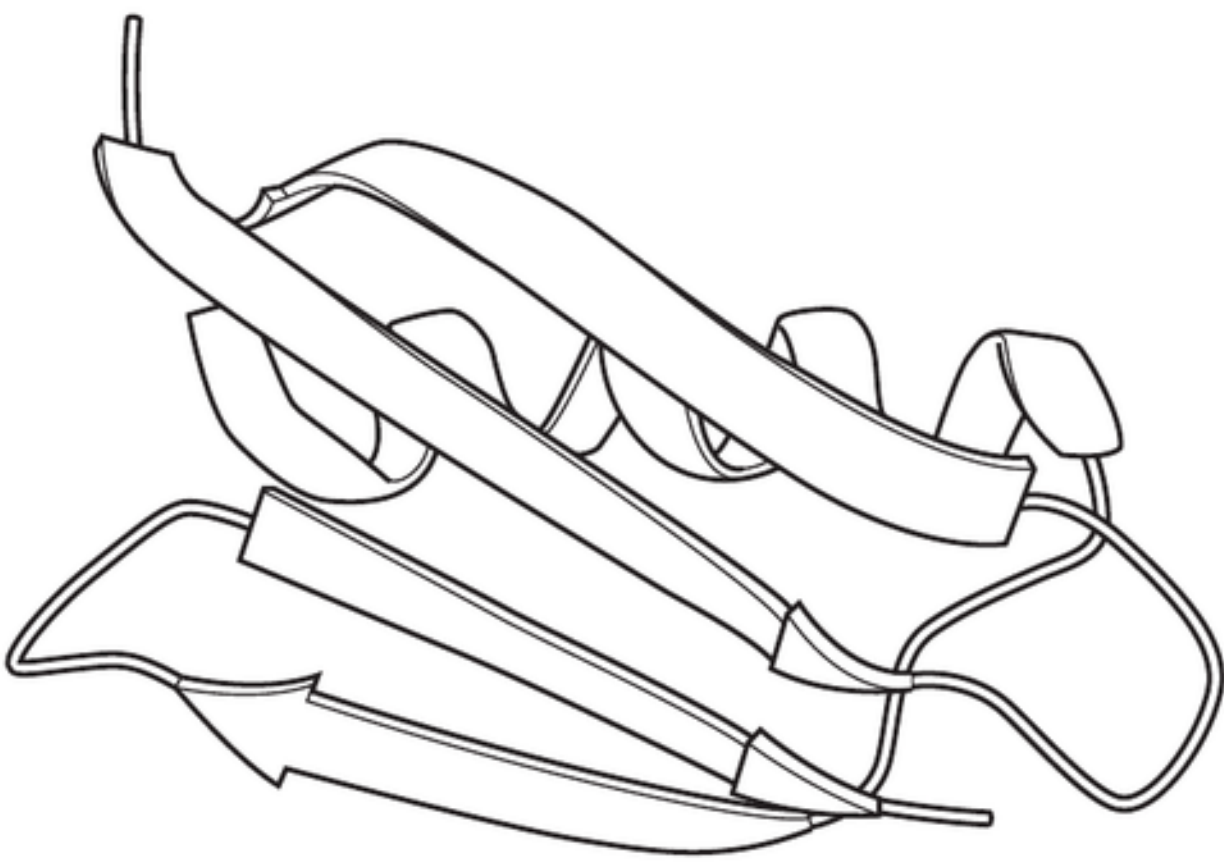


Fig. 1.2

(i) Describe the secondary structure of the protein shown in Fig. 1.2. [2]

(ii) Explain why the protein shown in Fig. 1.2 has tertiary structure, but not quaternary structure.

..... [2]

- (iii) An analysis of the amino acid composition of the protein in Fig. 1.2 showed that it does **not** contain any cysteine residues.

Explain how the three-dimensional structure of the protein shown in Fig. 1.2 is held in place.

.....
.....
.....
.....
.....
.....
.....
.....
..... [3]

[Total: 12]

Question No 37 - (9700_m21_22_1)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 2.3 - Proteins | (c) : 9.1
- The gas exchange system

(a) Fig. 1.1 is an image of a transverse section through the trachea of the gas exchange system.

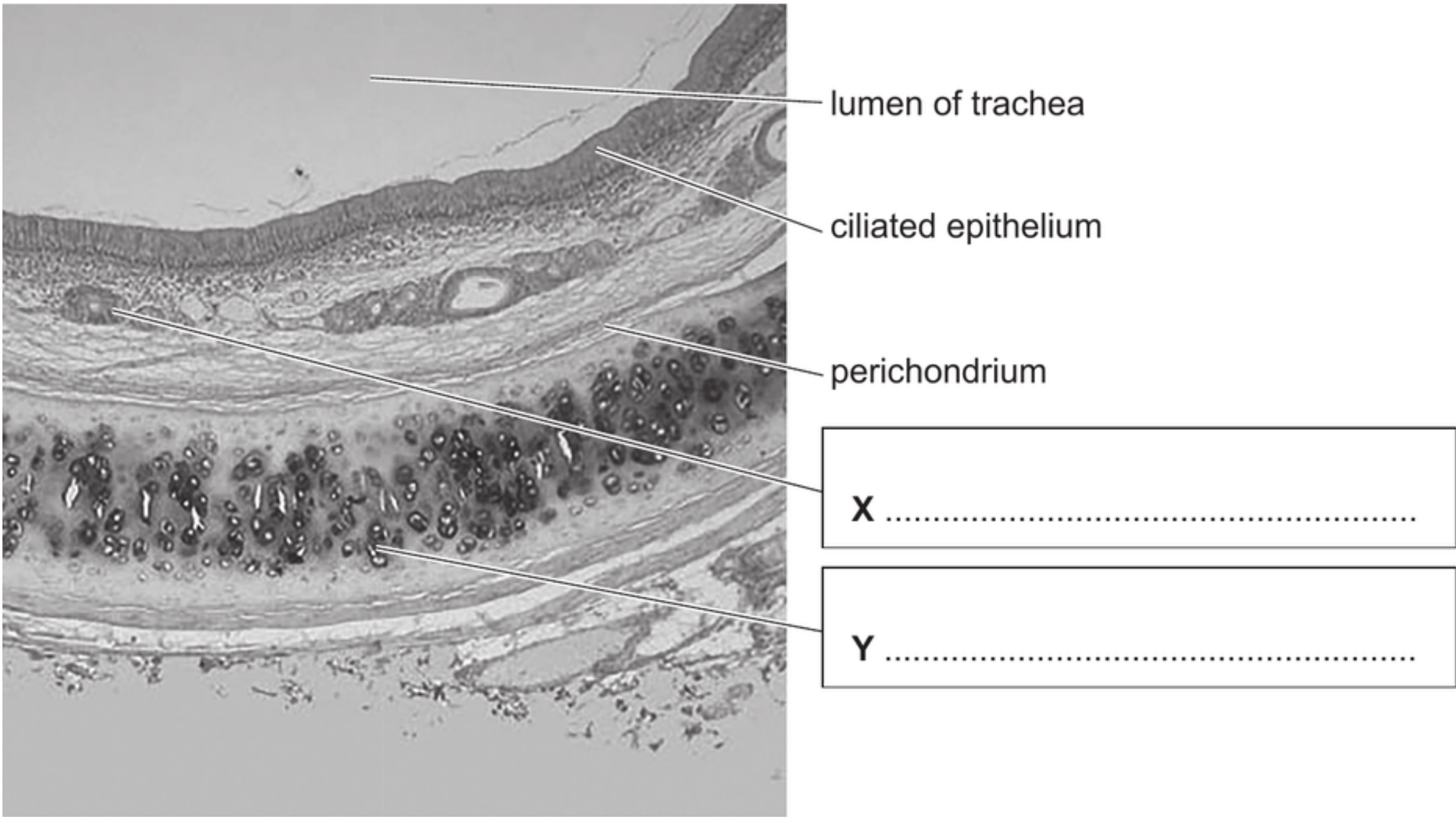


Fig. 1.1

Write the names of structures **X** and **Y** on Fig. 1.1 in the boxes provided. [2]

(b) The perichondrium contains collagen fibres, composed of collagen molecules.

Collagen is an example of one type of biological molecule.

State the name of the type of biological molecule of which collagen is an example.

..... [1]

(c) Some structures in the gas exchange system are listed in alphabetical order in Table 1.1.

- Write **YES** in the box provided if the structure contains smooth muscle.
- Write **NO** in the box provided if the structure does **not** contain smooth muscle.

Table 1.1

alveolus	
bronchiole	
bronchus	
trachea	

[1]

[Total: 4]

Question No 38 - (9700_m21_22_3)

Subsection Topics: (a) : 11.1 - The immune system | (b) : 1.2 - Cells as the basic units of living organisms |
(c) : 4.2 - Movement into and out of cells

T-helper lymphocytes and Leydig cells are two types of mammalian cells. The main role of T-helper lymphocytes and Leydig cells is to synthesise and secrete cell-signalling molecules.

- T-helper lymphocytes synthesise proteins known as cytokines.
- Leydig cells synthesise the steroid (lipid) hormone testosterone from cholesterol. Leydig cells also synthesise cholesterol.

(a) State **one** way in which cytokines are involved in an immune response.

.....

.....

..... [1]

(b) Fig. 3.1 shows part of a mammalian cell.



Fig. 3.1

(i) State, with reasons, whether Fig. 3.1 shows part of a Leydig cell or part of a T-helper lymphocyte.

.....

.....

.....

.....

(ii) Underline the correct name for the type of image shown in Fig. 3.1 **and** explain your choice.

photomicrograph

scanning electron micrograph

transmission electron micrograph

explanation

.....

.....

.....

..... [2]

(c) Testosterone molecules and cytokine molecules are transported in the circulatory system to reach their target cells. Testosterone molecules are able to enter their target cells and bind to receptors within the cytoplasm.

(i) Outline **one** way in which testosterone molecules could enter their target cells.

.....

.....

.....

.....

..... [2]

(ii) Cytokine molecules are not able to enter their target cells.

Suggest **and** explain why cytokine molecules are **not** able to cross the cell surface membrane to enter their target cells.

.....

.....

.....

.....

..... [2]

[Total: 9]

Question No 39 - (9700_m21_22_4)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 8.2 - Transport of oxygen and carbon dioxide | (c) : 10.1 - Infectious diseases

(a) Using a light microscope at a magnification of $\times 400$, it is possible to identify different types of blood cell in prepared slides of mammalian blood.

Fig. 4.1 is a key to identify different types of blood cell in prepared slides of mammalian blood.

In Fig. 4.1, letters **C**, **D**, **E** and **F** represent four different types of blood cell.

key

1a nucleus present go to 2

1b nucleus absent **C**

2a large rounded (spherical) nucleus **D**

2b nucleus not rounded go to 3

3a nucleus is kidney shaped **E**

3b nucleus is lobed **F**

Fig. 4.1

(i) Identify the cell types **C**, **D**, **E** and **F** in Fig. 4.1.

C

D

E

F [3]

(ii) Explain why blood taken from a person with an infectious disease may have a different number of white blood cells compared with blood taken from a healthy person.

.....

.....

.....

.....

..... [2]

As part of a research project, a team of doctors and scientists carried out tests to investigate the effect of altitude on the ability of blood to carry oxygen. They assessed the changes in the oxygen-carrying ability of their own blood as they walked from 1530 m above sea level to 5700 m above sea level, over a period of 14 days. 5700 m above sea level is an extremely high altitude.

Table 4.1 is a summary of some of their results.

Table 4.1

	day 1 at 1530 m	day 14 at 5700 m
percentage saturation of haemoglobin with oxygen in blood leaving the lungs	95	82
volume of oxygen delivered to tissues by 100 cm ³ of blood / cm ³	19.3	19.2

(b) Compare the results for day 1 with the results for day 14 in Table 4.1 **and** explain the results shown for **day 14**.

.....

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.....

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.....

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.....

.....

..... [4]

(c) The results of the research project have led to an improved understanding of diseases such as sickle cell anaemia.

Explain why sickle cell anaemia is an example of a disease.

.....

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.....

..... [2]

Question No 40 - (9700_s21_23_6)

Subsection Topics: (a) : 1.1 - The microscope in cell studies | (b) : 6.1 - Structure of nucleic acids and replication of DNA | (c) : 5.2 - Chromosome behaviour in mitosis | (d) : 5.2 - Chromosome behaviour in mitosis

The best time to obtain a clear image of chromosomes during a mitotic cell cycle is during the metaphase stage.

Fig. 6.1 is a scanning electron micrograph of a group of human chromosomes at metaphase.

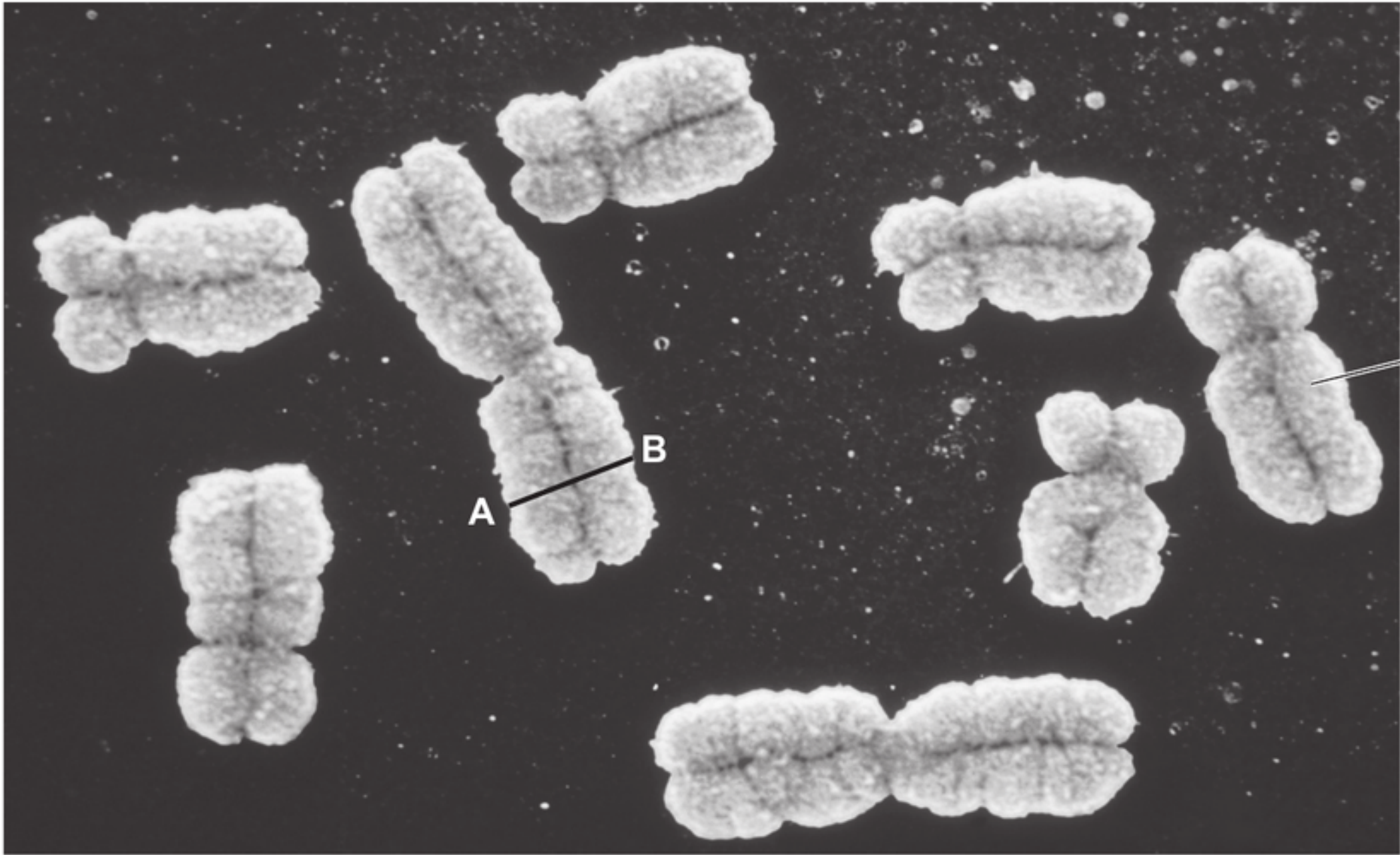


Fig. 6.1

(a) The group of chromosomes shown in Fig. 6.1 is magnified many times.

The actual width of the human chromosome between **A—B** is 1400 nm.

Calculate the magnification of the scanning electron micrograph shown in Fig. 6.1.

magnification × [2]

(b) Draw chromosome **C** in Fig. 6.1 in the space provided.

Label your drawing to show the structure of the chromosome.

[4]

- (c) Suggest why the metaphase stage is the best time during a mitotic cell cycle to obtain a clear image of chromosomes.

.....

.....

..... [1]

- (d) Name the stage of mitosis that immediately follows metaphase.

..... [1]

[Total: 8]

Question No 41 - (9700_s21_23_1)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 2.2 - Carbohydrates and lipids | (c) : 1.2 - Cells as the basic units of living organisms

The Golgi body, rough endoplasmic reticulum (RER) and smooth endoplasmic reticulum (SER) form part of the internal membrane system of a cell. The membranes have a fluid mosaic structure.

Fig. 1.1 is a transmission electron micrograph of one area of a liver cell showing a region with RER and a region with SER. Mitochondria are also visible in the image.

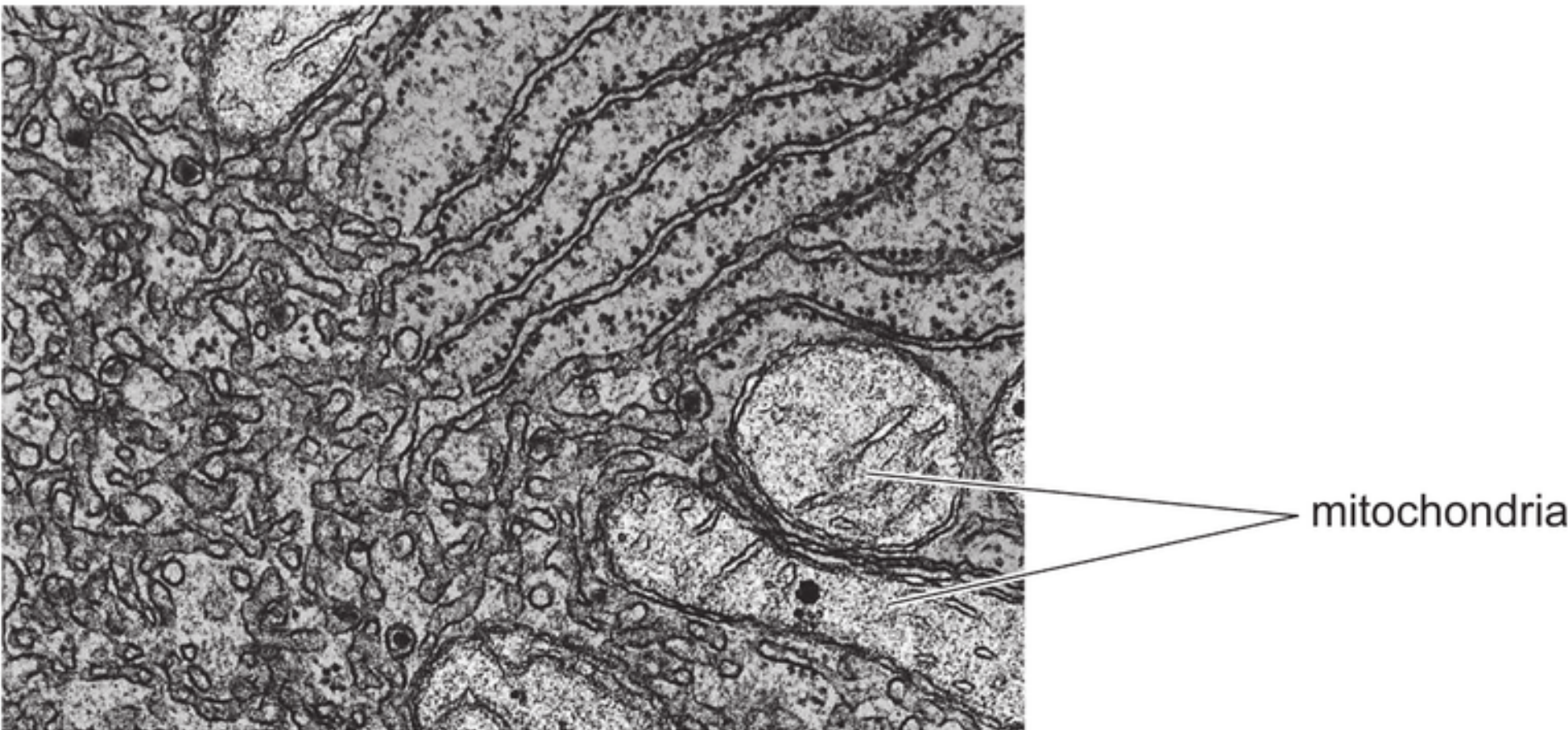


Fig. 1.1

(a) Describe the differences in structure **and** function between RER and SER.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(b) Phospholipids are one of the main components of membranes.

Describe the structure of a phospholipid molecule.

.....

.....

.....

.....

(c) One function of a Golgi body is to package molecules into Golgi vesicles.

(i) A Golgi body and Golgi vesicles are **not** visible in Fig. 1.1.

Describe the features, **other than** the presence of Golgi vesicles, that would help you identify a Golgi body in a transmission electron micrograph of another area of the same liver cell.

.....

.....

.....

.....

..... [2]

(ii) Some Golgi vesicles contain secretory proteins for release from the cell.

Describe the sequence of events that occurs following the packaging of a secretory protein into a Golgi vesicle to its release from the cell.

.....

.....

.....

.....

..... [3]

- (iii) Some Golgi vesicles contain glycoproteins or glycolipids to be added to the cell surface membrane.

Outline the role of **glycolipids** in the cell surface membrane.

.....

.....

..... [1]

[Total: 11]

Question No 42 - (9700_s21_23_5)
Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 8.3 - The heart | (c) :
9.1 - The gas exchange system

(a) Fig. 5.1 shows four types of cell that can be seen in a prepared slide of blood taken from a mammal.

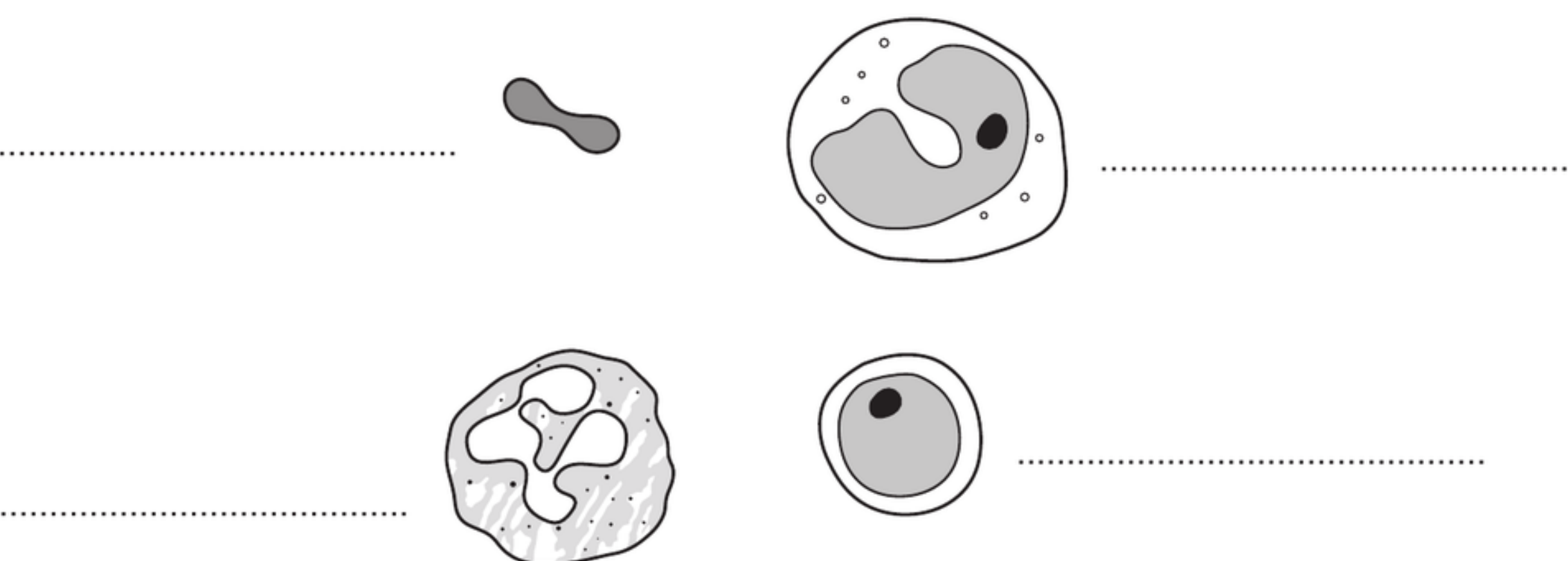


Fig. 5.1

Identify the four types of cell shown in Fig. 5.1.

Write the name of the cell type on the answer line provided by each cell in Fig. 5.1. [4]

(b) During systole and diastole of the cardiac cycle, changes in blood pressure occur in the four chambers of the heart.

Fig. 5.2 shows changes in the blood pressure in the **left** side of the heart and the aorta during one cardiac cycle.

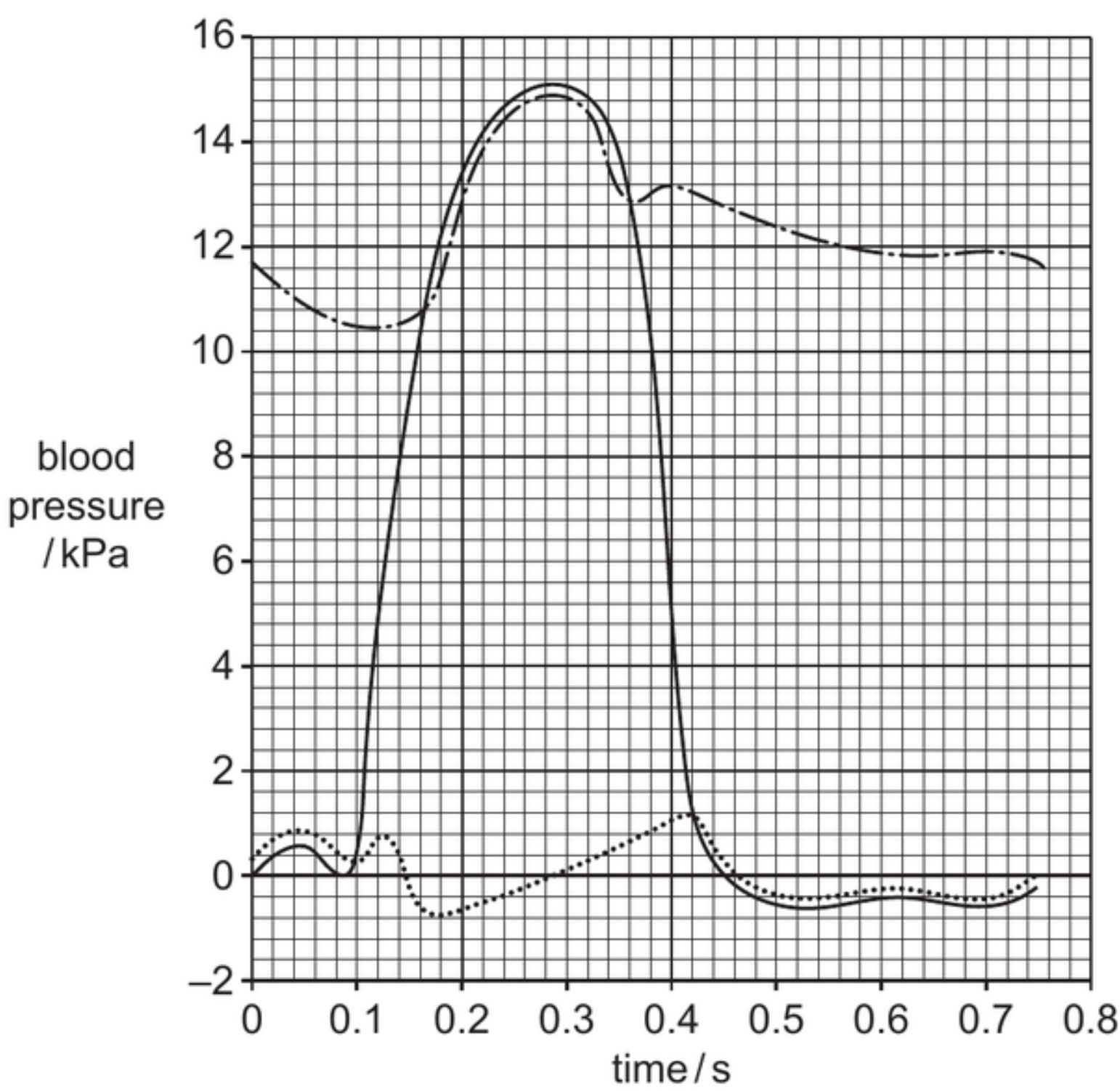


Fig. 5.2

With reference to the blood pressure changes shown in Fig. 5.2:

- state the maximum blood pressure reached in the left ventricle kPa
- state the time at which the bicuspid (left atrioventricular) valve closes. s

[2]

(c) Chronic obstructive pulmonary disease (COPD) can cause a condition known as pulmonary hypertension. This involves an increase in systolic blood pressure in the right ventricle and in the pulmonary arteries.

Fig. 5.3 is a summary of some of the events that can result from COPD.

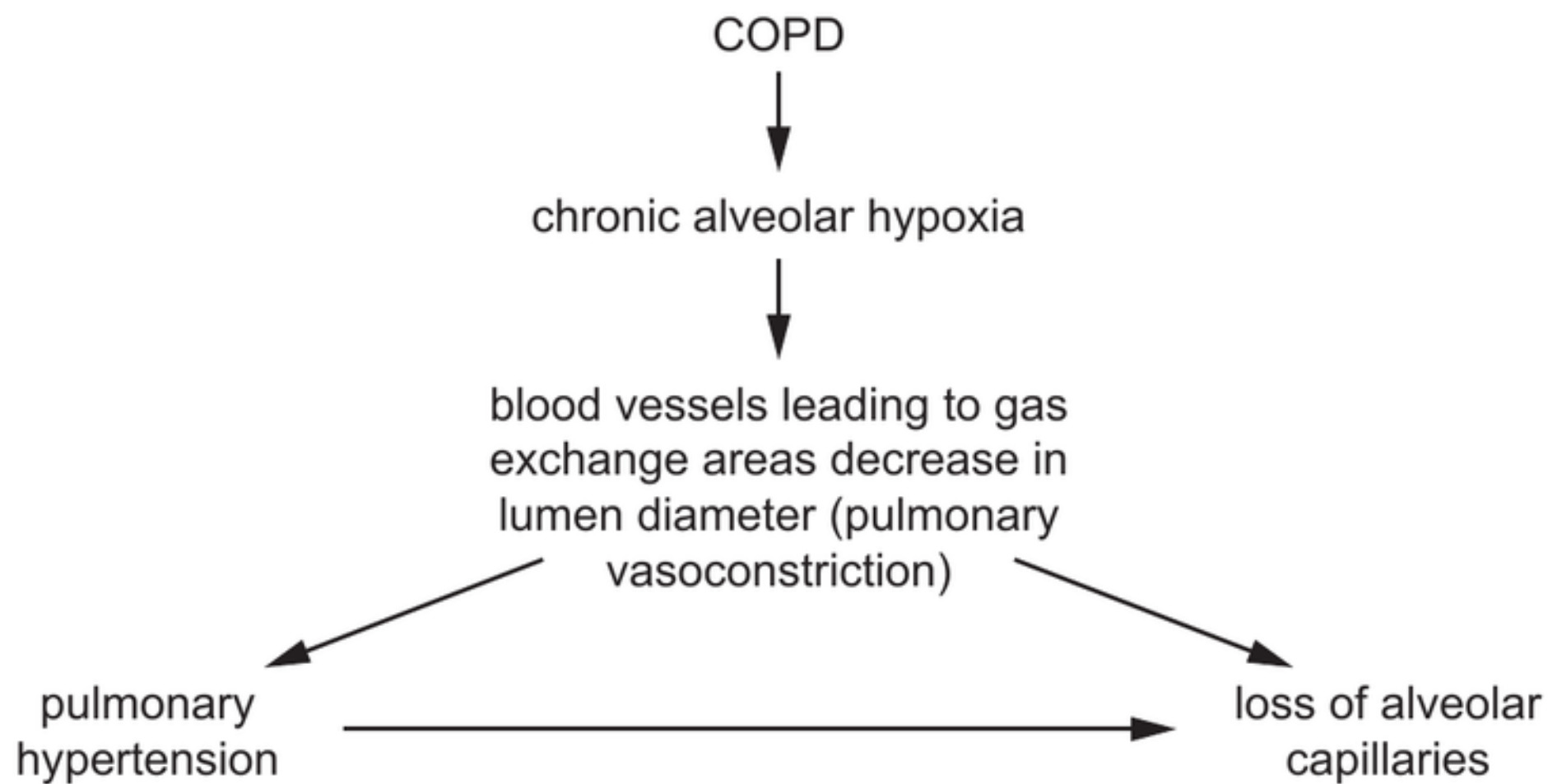


Fig. 5.3

- (i) Chronic alveolar hypoxia describes a condition where the partial pressure of oxygen in the gas exchange regions of the lungs is always lower than normal.

Explain how COPD leads to chronic alveolar hypoxia.

.....

.....

.....

.....

.....

.....

..... [3]

- (ii) Explain how the loss of alveolar capillaries affects the functioning of the lungs in a person with COPD.

Answer for Question 1 (9700_m25_22_5)

Question	Answer	Marks												
5(a)	histones ; chloroplasts ; bacteria / cyanobacteria / Archaea ; accept named prokaryote cytoplasm ;	4												
5(b)(i)	non-transcribed strand ;	1												
5(b)(ii)	primary transcript ;	1												
5(b)(iii)	<table><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>A</td><td>U</td><td>G</td><td>C</td><td>A</td><td>U</td></tr></table> ;	1	2	3	4	5	6	A	U	G	C	A	U	1
1	2	3	4	5	6									
A	U	G	C	A	U									

Question	Answer	Marks
5(c)	any three from 1 ref. to non-competitive inhibition ; 2 binding of alpha-amanitin changes shape of active site ; 3 active site, no longer / less, complementary to, substrate / DNA or 4 prevents RNA polymerase from, binding to DNA / unwinding DNA / rewinding DNA ; 5 blocks movement of the polypeptides of the enzyme / prevents the enzyme changing shape / hinders induced fit ; 6 RNA polymerase movement along DNA, prevented / slowed down ; accept prevents addition of nucleotides to the chain	3

Answer for Question 2 (9700_m25_22_1)

Question	Answer	Marks
1(a)	light / optical (microscope) ;	1
1(b)	460 / 464 (μm) ; A 450–480	1
1(c)	any one from: increase the surface area ; reach a larger volume of, soil / soil particles ; AVP ; e.g. (root hairs) increase the number of aquaporins in cell surface membrane	1
1(d)	max two if answer only refers to either Na^+ or K^+ ions any three from: 1 facilitated diffusion because, higher concentration Na^+ in soil solution / lower concentration Na^+ in root hair cells ; 2 active, transport / uptake, because, higher concentration K^+ in root hair cells / lower concentration K^+ in soil solution ; 3 ions / AW, cannot, diffuse / pass through the, cell (surface) membrane / phospholipid bilayer ; 4 (so) facilitated diffusion uses, channel / carrier proteins or active transport uses carrier proteins ;	3
1(e)	(movement of water) from cell A to cell B by osmosis ; from higher water potential to lower water potential / from less negative ψ to more negative ψ / down the water potential gradient ;	2
1(f)(i)	any four from: 1 (carbon dioxide reacts with water resulting in) carbonic acid produced ; accept from equation 2 carbonic acid dissociates to form, hydrogencarbonate (ions) / HCO_3^-, and, protons / H^+ ; accept from equation accept bicarbonate for hydrogencarbonate 3 pH of soil (solution) lowered / soil (solution) becomes more acidic ; accept correct paired data quotes as alternative to lower pH 4 at lower pH clay particles lose Fe^{2+} / H^+ displaces Fe^{2+} from clay particles ; 5 hydrogencarbonate ions attract (bound) Fe^{2+} into soil solution ; 6 AVP ; e.g. no carbonic anhydrase in soil solution, so reaction slow	4

Answer for Question 2 (9700_m25_22_1)

Question	Answer	Marks
1(f)(ii)	any three from: 1 (Fe²⁺) must cross the cell surface membrane at endodermis / Fe²⁺ moves into, cytoplasm / symplastic route ; 2 due to Casparian strip / impermeability of suberin / AW ; 3 idea that the cell regulates the, quantity / activity, of transport proteins ; 4 metabolised / changed, to insoluble iron compounds (and stored in root) ; 5 transported into / stored in, vacuole of endodermal cell ;	3

Answer for Question 3 (9700_m24_22_6)

Question	Answer	Marks
6(a)	capsid ; A capsomere or protein coat R protein / glycoprotein / capsid	1
6(b)	<i>accept accounts based on primary and / or secondary immune response .</i> fewer cytokines released ; <i>and any two from:</i> fewer plasma cells, so fewer antibodies produced ; A B lymphocytes fewer macrophages stimulated / less production of 'angry' macrophages / AW / less antigen presentation by macrophages ; fewer T-killer cells stimulated to divide / less T-killer cells / less infected cells killed (by T-killer cells) ; fewer memory cells (produced by the primary response) ; AVP ;	3
6(c)	virus cannot enter the T-helper cell / CCR5 unable to trigger endocytosis of viral particle ;	1
6(d)	<i>any three from:</i> 1 (named) small mammal, injected / AW, with CCR5 ; A antigen 2 immune response occurs (over several weeks) ; A immune response described 3 plasma cells / B-lymphocytes / B-cells / splenocytes, extracted from spleen ; 4 plasma cells / B-lymphocytes / B-cells, fused with, myeloma / tumour / cancer / AW, cells (to form hybridomas) ; 5 screening / selection / AW, for hybridomas producing desired, (monoclonal) antibodies ; 6 AVP ; e.g. hybridoma cells separated (into wells) to produce clones ref. to large scale production	3

Answer for Question 4 (9700_m24_22_1)

Question	Answer	Marks
1(a)(i)	glycerol ;	1
1(a)(ii)	any one from: hydroxyl / polar, group, interacts with, phosphate heads ; A idea that both are, polar / hydrophilic A hydroxyl group, faces aqueous environment / AW, as it is, polar / hydrophilic non-polar part, in region of / AW, fatty acid tails / AW, as both are, non-polar / hydrophobic ; A non-polar part is hydrophobic so, in centre of membrane / away from aqueous environment	1
1(a)(iii)	any one from: maintains / regulates, fluidity of membrane ; A detail e.g. reduces fluidity at high temperature / increases fluidity at low temperature / AW maintains / regulates, (mechanical) stability of membrane ; AW prevents entry of, hydrophilic substances / polar substances / ions ; without cholesterol membranes would easily rupture flat ring (<i>structure</i>) interferes with the movement of fatty acid tails reduces lateral movement of phospholipids	1
1(b)(i)	sodium ions are (positively charged), so repelled / AW, by the, hydrophobic tails / non-polar core / non-polar tails / AW ;	1

Answer for Question 4 (9700_m24_22_1)

Question	Answer	Marks								
1(b)(ii)	<i>similarity:</i> any one from 1 both occur through / involve, a, membrane / transport, protein ; A carrier protein <i>if context is correct</i> 2 (both can be) specific to the, molecule / ion (passing through) ; A correct ref. to binding site(s) on protein 3 (both involve) conformational change of (carrier) protein) ; R if incorrect context of channel protein AVP ; e.g. can transport substances, into and out of cell / in both directions ; <i>differences:</i> <table><tr><td><i>facilitated diffusion</i></td><td><i>active transport</i></td></tr><tr><td>substances transported down the concentration gradient</td><td>substances transported against a concentration gradient</td></tr><tr><td>passive A does not require, ATP / (metabolic) energy</td><td>requires, ATP / (metabolic) energy</td></tr><tr><td>involves channel and carrier proteins</td><td>does not involve channel proteins / only involves carrier proteins</td></tr></table> <i>If not given as a similarity allow as differences</i> <i>idea that active transport always involves conformational change (facilitated diffusion only carrier protein)</i> <i>idea that active transport always involves specific binding site(s) (facilitated diffusion only with carrier proteins)</i>	<i>facilitated diffusion</i>	<i>active transport</i>	substances transported down the concentration gradient	substances transported against a concentration gradient	passive A does not require, ATP / (metabolic) energy	requires, ATP / (metabolic) energy	involves channel and carrier proteins	does not involve channel proteins / only involves carrier proteins	3
<i>facilitated diffusion</i>	<i>active transport</i>									
substances transported down the concentration gradient	substances transported against a concentration gradient									
passive A does not require, ATP / (metabolic) energy	requires, ATP / (metabolic) energy									
involves channel and carrier proteins	does not involve channel proteins / only involves carrier proteins									
1(c)(i)	any one from: SER (membrane-bound so) can provide, phospholipid / arachidonic acid / substrate ; (prostaglandins are lipids and) SER is involved in lipid transport ; prostaglandins can be transported (from SER) or stored (in SER) ; idea of compartmentalisation / separated from other reactions in the cytoplasm / provides optimum conditions for pathway / higher concentration of enzymes (of pathway) ;	1								

Answer for Question 4 (9700_m24_22_1)

Question	Answer	Marks
1(c)(ii)	any three from: ref. to effect on, ionic bonding / hydrogen bonding / hydrophobic interactions, (with other R-groups) ; changes the, shape / conformation, of the active site ; active site no longer complementary to, arachidonic acid / substrate ; ref. to effect of activation energy not being reduced ; e.g. ref to changed charges (so no electron transfer) no longer provides hydrophobic regions for reaction to occur enzyme–substrate complex, not formed / formed at reduced rate ;	3
1(c)(iii)	any two from: A ligands for prostaglandins <i>if in correct context</i> 1 prostaglandins are, secreted / released, by cells or prostaglandins are, transported / AW, to target cells ; 2 prostaglandins bind to receptors (on target cell surface membranes) ; R antigens 3 example of events triggered leading to a response ; e.g. activation of secondary messenger enzyme, cascade / activation phosphorylation events signal transduction	2

Answer for Question 5 (9700_m24_22_5)

Question	Answer	Marks
5(a)(i)	scanning (electron microscope) ;	1
5(a)(ii)	<i>Vibrio cholerae</i> ;	1
5(b)	prokaryotic cell walls are, made of peptidoglycan / made of murein / not made of cellulose ;	1

Answer for Question 6 (9700_m24_22_3)

Question	Answer	Marks
3(a)(i)	R endodermis ; A endodermal (tissue) S xylem ; T phloem ; <i>accept ecf if S and T both have 'vessels' after naming</i>	3
3(a)(ii)	any two from: to stop water moving through the apoplast / to force water movement to be symplastic / AW ; so that water moves from the cell wall to the cytoplasm ; AVP ; e.g. to allow control of substances into root (stele) ref. to passage cells ref. to Casparian strip / suberin	2
3(a)(iii)	sucrose / amino acid / peptide / polypeptide / protein / RNA / (named) plant hormone ; A other named sugar / named amino acid / named protein / enzyme R minerals	1
3(b)	correct label to a plasmodesma ;	1

Question	Answer				Marks
3(c)					3
	polysaccharide	monomer	glycosidic bond(s)	function	
	amylopectin	α -glucose	1,4 and 1,6	energy storage in plants	
	amylose	α -glucose ;	1,4	energy storage in plants	
	cellulose	β -glucose	1,4 ;	structural role in plant cell walls	
	glycogen	α -glucose	1,4 and 1,6	energy storage in <u>animals</u> ;	

Answer for Question 7 (9700_s24_21_1)

Question	Answer	Marks																				
1(a)(i)	7 <u>nm</u> ; A a suitable range A within the range 5 to 10 <u>nm</u> <i>unit must be shown</i>	1																				
1(a)(ii)	<i>one mark per row – name and letter must agree in row 3 – glycolipid and glycoprotein</i> If no rows are correct or one row is correct, mark by column to give max 2 if one or two columns are correct <table><tr><th>component</th><th>function</th><th>letter on Fig.1.1</th><th></th></tr><tr><td>channel protein</td><td>facilitated diffusion or transport of, water / ions / water soluble substances / polar molecules / charged substances / hydrophilic substances I named examples of each category</td><td>A</td><td>;</td></tr><tr><td>phospholipid</td><td>forms a bilayer or a role within bilayer e.g. barrier to, water soluble / polar substances / ions allows diffusion of, fat soluble / non-polar, substances allows fluidity / provides stability / forms a hydrophobic core / AW</td><td>E</td><td>;</td></tr><tr><td>glycoprotein A glycolipid</td><td>receptor for cell signalling</td><td>B D</td><td>;</td></tr><tr><td>cholesterol</td><td>gives (mechanical) stability / maintains fluidity / regulates fluidity / barrier to water soluble substances or at low temperatures, maintains or increases fluidity / prevents close packing A prevents hydrophobic 'tails' interacting at low temperatures or at high temperatures, stabilises the membrane / decreases fluidity</td><td>F</td><td>;</td></tr></table>	component	function	letter on Fig.1.1		channel protein	facilitated diffusion or transport of, water / ions / water soluble substances / polar molecules / charged substances / hydrophilic substances I named examples of each category	A	;	phospholipid	forms a bilayer or a role within bilayer e.g. barrier to, water soluble / polar substances / ions allows diffusion of, fat soluble / non-polar, substances allows fluidity / provides stability / forms a hydrophobic core / AW	E	;	glycoprotein A glycolipid	receptor for cell signalling	B D	;	cholesterol	gives (mechanical) stability / maintains fluidity / regulates fluidity / barrier to water soluble substances or at low temperatures, maintains or increases fluidity / prevents close packing A prevents hydrophobic 'tails' interacting at low temperatures or at high temperatures, stabilises the membrane / decreases fluidity	F	;	4
component	function	letter on Fig.1.1																				
channel protein	facilitated diffusion or transport of, water / ions / water soluble substances / polar molecules / charged substances / hydrophilic substances I named examples of each category	A	;																			
phospholipid	forms a bilayer or a role within bilayer e.g. barrier to, water soluble / polar substances / ions allows diffusion of, fat soluble / non-polar, substances allows fluidity / provides stability / forms a hydrophobic core / AW	E	;																			
glycoprotein A glycolipid	receptor for cell signalling	B D	;																			
cholesterol	gives (mechanical) stability / maintains fluidity / regulates fluidity / barrier to water soluble substances or at low temperatures, maintains or increases fluidity / prevents close packing A prevents hydrophobic 'tails' interacting at low temperatures or at high temperatures, stabilises the membrane / decreases fluidity	F	;																			

Answer for Question 7 (9700_s24_21_1)

Question	Answer	Marks
1(b)(i)	<i>each organelle must be drawn in the cytoplasm and labelled for a mark</i> <i>max 2 if organelles are drawn correctly but not labelled or are not labelled correctly</i> <i>labels must clearly identify the organelles</i> R any 3D drawings mitochondrion with two membranes and at least one crista ; rough endoplasmic reticulum with at least one cisterna (two lines close together) and ribosomes attached on the outside ; R if any ribosomes completely inside the organelle smooth endoplasmic reticulum with at least one tube with no ribosomes ; A RER and SER as labels A if RER or SER attached to nuclear envelope	3
1(b)(ii)	Golgi body / dictyosome ; A Golgi, apparatus / complex <i>plus any one from:</i> modifies / processes, protein(s) / polypeptide(s) / lipid(s) ; A any suitable type of modification or a description e.g. glycosylation / addition of sugars forming tertiary or quaternary structures packaging of proteins into (Golgi) vesicles ; I transports AVP ; e.g. forming lysosomes / cell wall enzymes assembled	2

Answer for Question 8 (9700_s24_22_2)

Question	Answer	Marks								
2(a)(i)	one mark each correct row <table><tr><th>cell structure</th><th>function</th></tr><tr><td>nucleolus ;</td><td>manufactures ribosomal subunits from proteins and ribosomal RNA</td></tr><tr><td>smooth endoplasmic reticulum ; R endoplasmic</td><td>synthesises triglycerides and other lipids</td></tr><tr><td>pair of centrioles ; R centrosomes</td><td>organise microtubules of the cell cytoskeleton</td></tr></table>	cell structure	function	nucleolus ;	manufactures ribosomal subunits from proteins and ribosomal RNA	smooth endoplasmic reticulum ; R endoplasmic	synthesises triglycerides and other lipids	pair of centrioles ; R centrosomes	organise microtubules of the cell cytoskeleton	3
cell structure	function									
nucleolus ;	manufactures ribosomal subunits from proteins and ribosomal RNA									
smooth endoplasmic reticulum ; R endoplasmic	synthesises triglycerides and other lipids									
pair of centrioles ; R centrosomes	organise microtubules of the cell cytoskeleton									
2(a)(ii)	structures should be labelled and drawn with enough detail not to be mistaken for another structure all three correct = 2 marks one or two correct = 1 mark all three structures correctly drawn but no labels = 1 mark - roughly spherical organelle within the nucleus labelled as nucleolus - minimum of one single membrane-bound tubular sac labelled as, smooth endoplasmic reticulum / smooth ER / SER R if dots (ribosomes) drawn and resembles RER - two, short lines or cylinders, not parallel to each other labelled as (pair of) centrioles R if inside the nucleus	2								

Answer for Question 8 (9700_s24_22_2)

Question	Answer	Marks
2(b)(i)	<i>allow, M. tuberculosis / pathogens / bacteria, for bacterial cells</i> endocytosis occurs / described ; e.g. (macrophage cell surface) membrane, surrounds / AW, bacterial cells pseudopodia, surrounds / form round / AW, bacterial cell (alveolar) macrophage / phagocyte / (phagocytic) cell, envelops / engulfs, bacterial cells ; event occurring before <u>or</u> after ; <i>e.g. before</i> <i>ref. to</i> chemotaxis / chemotactic response bacterial cells / bacteria / (bacterial) antigens, bind / attach / join / AW, to (macrophage cell surface), receptors / membrane I binding to, macrophage / cell <i>suggestion of</i> (in alveolar space) opsonisation of /antibody binding to, bacterial cells <i>e.g. after</i> membrane fusion / (phagocytic), vacuole pinches off / AW A vesicle for vacuole	2
2(b)(ii)	lysosomes / lysosome ; A lysosomal vesicles	1

Answer for Question 8 (9700_s24_22_2)

Question	Answer	Marks
2(c)	any four from: 1 cells are replicating / AW (because live vaccine) ; 2 high / increased / AW, levels of (non-self / foreign) antigen (because live vaccine) ; 3 (so) strong / effective / good / AW, (primary) <u>immune response</u> ; A described e.g. (T-/B-) memory cells are formed <i>idea that</i> memory cells present when <i>Mycobacterium</i> infects / AW secondary response occurs when <i>Mycobacterium</i> infects / AW 4 provides (artificial) active immunity ; R natural active immunity 5 (so) boosters not needed (to build sufficient immunity) ; 6 vaccine does not cause, disease / TB (because, weakened / attenuated) ; I doesn't show symptoms 7 easy to, transport / store / deliver (because freeze-dried) ; 8 AVP ;; e.g. effective against <i>M. tuberculosis</i> and <i>M. bovis</i> no / few / mild, side effects, so people not discouraged (from having vaccine) memory cells / immunity, (relatively) long-lived / long-lasting only need one dose (good immunity for most individuals) provides herd immunity (<i>a consequential effect</i>)	4

Answer for Question 9 (9700_s24_22_1)

Question	Answer	Marks
1(a)	any two from: 1 (by) contracts / contracting / contraction, and, relaxes / relaxing / relaxation ; <i>must be in context of bronchioles</i> R if includes <i>ref. to stretch / expand / recoil</i> R if in context of <i>bronchus or trachea (then ecf in subsequent mps)</i> 2 diameter / lumen size, can be, controlled / changed ; AW A contraction, decreases diameter (of lumen) / constricts A relaxation (after contraction) increases diameter (of lumen) / widens / dilates / expands R vasoconstriction / vasodilation 3 <i>idea of</i>, controls / regulates, flow of air / volume of air flowing ; AW I statements such as 'lets air in' / 'allows inhalation and exhalation' A oxygen in / carbon dioxide out, <i>instead of air flow</i> R oxygen out and carbon dioxide 4 AVP ; e.g. contract to, reduce air movement / prevent entry of contaminants <i>idea of normally relaxed but can, contract / cause constriction, when needed</i> <i>max 1 if response relates function to inhalation and exhalation</i> <i>0 marks if incorrectly stated as <u>elastic tissue or elastic fibres</u></i>	2
1(b)(i)	stage micrometer / stage micrometer scale ;	1

Answer for Question 9 (9700_s24_22_1)

Question	Answer	Marks
1(b)(ii)	yes, qualified ; e.g. $0.2 \text{ mm} = 200 \mu\text{m}$ 0.2 mm / smallest student can see, is less than 0.25 mm $250 \mu\text{m} = 0.25 \text{ mm}$ $250 \mu\text{m}$ / cell length, is longer than $200 \mu\text{m}$ the cell is $50 \mu\text{m}$ longer (than 0.2 mm) the cell is 0.05 mm longer (than 0.2 mm) <i>allow if converted to standard form (2×10^{-4} v $2.5 \times 10^{-4} \text{ m}$)</i> <i>must have units</i> <i>must include numerical values</i>	1
1(c)(i)	any two from: wall, of one layer / is one cell thick ; I capillary is one cell thick A thin wall / endothelial cells are a single layer A endothelium is, a single layer (of cells) / one cell thick <i>idea that</i> red blood cells transported in single file ; <i>idea that</i> red blood cells diameter (approximately), as large / same, as capillary (lumen) ; A if diameter (e.g. $7 \mu\text{m}$) stated as being similar to capillary size <i>idea of</i> diameter of capillary narrower than smooth muscle cell ; AVP ; e.g. no muscle and elastic layer muscle fibres / elastic fibres / collagen, not present <i>ref. to</i> different shapes of red blood cell / red blood cell showing flexibility, to pass through (narrow) capillary	2

Answer for Question 9 (9700_s24_22_1)

Question	Answer	Marks
1(c)(ii)	<i>allow tissue fluid / fluid surrounding cells, instead of (smooth muscle) cells</i> <i>allow, blood / plasma, for capillary</i> <i>allow O₂ for oxygen and CO₂ for carbon dioxide</i> any three from: <i>capillary function</i> 1 named, substance / type of substance, that is supplied to smooth muscle cells or is a product removed from the cells ; e.g. (supply) oxygen / nutrients / glucose / amino acids / cell-signalling molecule e.g. (removes) carbon dioxide / lactic acid / waste A exchange of respiratory gases (between capillary and cells) I plasma proteins into tissue fluid <i>structure to function</i> 2 thin wall / AW, so short distance ; R capillary is thin 3 endothelial pores / fenestrations, for more efficient passage / AW ; A gaps, between / within, (endothelial) cells (of capillary wall) A increases, quantity / rate of supply (of substances) A endothelial pores for formation of tissue fluid (around cells) R if <u>blood</u> leaves to make tissue fluid 4 (endothelial) pores / AW, for passage of, phagocytes / monocytes / macrophages / neutrophils ; 5 small (size) / narrow diameter, to reach cells / so (all) cells are close ; A value in range 5–10 µm A small size / narrow lumen, slows (rate of) blood flow 6 detail about <u>red blood cell</u> and, respiratory gases / gas exchange / oxygen / carbon dioxide ; e.g. narrow lumen slows red blood cell movement for uptake of oxygen slows red blood cell movement to increase time for exchange of gases only one red blood cell fits (at a time) so short diffusion distance red blood cells are close to (muscle) cells for gas exchange red blood cells squeeze through, (so) distance for oxygen to reach cells is minimised	3

Answer for Question 9 (9700_s24_22_1)

Question	Answer	Marks
1(d)(i)	(a gene mutation is a) change in the sequence of base pairs in a DNA molecule ; A change in the DNA, base / nucleotide, sequence I change in RNA base sequence I names of mutations codes for / may result in / results in / AW, an altered / a different / a changed, polypeptide ; A protein / amino acid sequence / primary structure, <i>for polypeptide</i>	2
1(d)(ii)	any two from: differences owing to, RNA / gene, splicing ; A primary transcript for RNA A ref. to alternative splicing R DNA splicing R mutation occurring during gene splicing (differences occur during) removal of, introns / non-coding sequences ; R if introns described as bases / nucleotides / codons R different number of introns removed / some introns remain exons / coding sequences, detail ; e.g. joined differently / in a different combination in middle (of transcript), removed / not included for repeating sequence, removed / not included (so) messenger RNA / mRNA, formed is different ;	2

Answer for Question 9 (9700_s24_22_1)

Question	Answer	Marks
1(d)(iii)	<i>allow ref. to binding sites as plural</i> <i>! ref. to active site(s)</i> <i>any one from:</i> (still have) similar, tertiary structure / binding site shape ; A similar 3D shape R same A <i>idea of</i> binding sites still complementary to attach to (the) proteins removed amino acids are not structural amino acids ; removed amino acids are not part of binding site ; A description R-group interactions (still) the, same / similar ; AVP ; e.g. idea of more than one binding site and only, one / a few, changed A same type of binding site, but a different number	1

Answer for Question 10 (9700_s24_23_1)

Question	Answer	Marks
1(a)(i)	capsid ; A capsomere A protein coat	1
1(a)(ii)	RNA / DNA ; (<i>actual is RNA</i>) I viral R dsRNA / dsDNA / mRNA / tRNA / rRNA	1
1(b)(i)	50 (nm) ; A 50 / 52.5 / 55 / 57.5 / 60 nm working showing use of correct formula, $A = I / M$; <i>length X–Y / ÷ magnification</i>	2
1(b)(ii)	ability to distinguish between two points ; AW	1
1(c)	malaria is transmitted by <i>Anopheles</i> (rather than <i>Aedes</i>) ; <i>plus any two from:</i> <i>max 1 if incorrect context stated for malarial transmission</i> both are transmitted by vectors ; both are transmitted by mosquitoes ; both, are blood-borne diseases / vectors feed on blood ;	3

Question	Answer	Marks
1(d)(i)	<i>max three if no correct ref. within response to, memory cells / immunological memory</i> A T- / B-cells, for, T- / B- lymphocytes <i>any three from:</i> 1 proteins are, <u>non-self</u> / <u>foreign</u>, <u>antigens</u> ; 2 proteins / antigens, stimulate a primary immune response ; 3 T-lymphocyte / B-lymphocyte, binding / recognition / clonal selection / activation / described in terms of receptor ; 4 clonal expansion / cell divides by mitosis to produce a clone / AW ; 5 formation of memory, (T- / B-) lymphocytes ; <i>mps 3, 4, 5 in context of primary immune response</i> 6,7 further detail ; e.g. (artificial) active immunity (T- / B-) memory cells, remain in, circulation / the body, for a long time or memory cells are long-lived (for secondary response) larger numbers of lymphocytes (specific to Zika virus) greater chance of encountering, Zika virus / pathogen / antigens secondary immune response is, stronger / faster / (than primary immune	4

Answer for Question 11 (9700_w24_21_3)

Question	Answer	Marks
3(a)	J cartilage ; K smooth muscle ; <i>difference</i> I <i>ref. to</i> other tissues <i>plus one from:</i> cartilage in bronchus but not the bronchioles ; suggestion for smooth muscle tissue (<i>ref. to K</i>) ; e.g. proportionally more smooth muscle in the wall of the bronchiole	3
3(b)(i)	<i>Mycobacterium tuberculosis</i> / <i>Mycobacterium bovis</i> ;	1
3(b)(ii)	antigen binding site(s) ; A variable region	1
3(b)(iii)	<i>any two from:</i> A antigen for TB protein A TB pathogen for pathogen causing TB (immobilised) monoclonal antibody has a binding site which is a complementary shape to the protein secreted by the TB pathogen ; monoclonal antibody on the test line will only bind with protein secreted by the by the TB pathogen ; <i>idea that</i> monoclonal antibodies with tiny gold particle are only held in place if protein secreted by the TB pathogen is present ; AVP ; e.g. <i>suggestion that</i> TB protein is specific to the TB pathogen	2

Answer for Question 11 (9700_w24_21_3)

Question	Answer	Marks
3(b)(iv)	<i>any two from:</i> different shaped, variable region / antigen binding site ; <i>ref. to different primary structure ;</i> <i>ref. to a different tertiary structure ;</i> <i>ref. to different (named) bonds holding the tertiary structure ;</i>	2
3(c)	<i>any three from:</i> provides (long-term) immunity ; <i>context of pathogen entering the body</i> <i>ref to secondary / fast / strong, immune response ;</i> because of presence of increased numbers of specific T-lymphocytes ; memory T-lymphocytes, recognise / bind to / activated by, the foreign antigen ; T- helper cells secrete. cytokine / interleukins ; I cell-signalling molecules example of consequence of increased cytokine release ; e.g. increased phagocytosis / angry macrophages increased, B-lymphocyte / humoral, response enhance T-killer cell response	3
3(d)(i)	endocytosis ; A phagocytosis	1

Answer for Question 11 (9700_w24_21_3)

Question	Answer	Marks
3(d)(ii)	any three from: some T-lymphocytes have receptors with a complementary shape to the antigen on the tumour cell ; antigens on the surface of the tumour cell bind to receptor / <i>ref. to</i> clonal selection ; T-lymphocytes, divide by mitosis / <i>ref. to</i> clonal expansion ; T-killer cells are produced that destroy the tumour cell ; method used by T-killer cell to destroy tumour cell ; e.g. perforin, hydrogen peroxide, granzymes A toxins <i>ref. to</i> B lymphocytes and antibodies ; AVP ; e.g. further detail of method used by T-killer cell <i>ref. to</i> phagocytosis of cancer cells	3

Answer for Question 12 (9700_w24_21_1)

Question	Answer	Marks																											
1(a)	<table><tr><th rowspan="2">organelle</th><th colspan="3">cell type</th></tr><tr><th>animal cells</th><th>plant cells</th><th>prokaryotic cells</th></tr><tr><td>nucleus</td><td>✓</td><td>✓</td><td>✗</td></tr><tr><td>large permanent vacuole</td><td>✗</td><td>✓</td><td>✗ ;</td></tr><tr><td>rough endoplasmic reticulum</td><td>✓</td><td>✓</td><td>✗ ;</td></tr><tr><td>Golgi body</td><td>✓</td><td>✓</td><td>✗ ;</td></tr><tr><td>centrioles</td><td>✓</td><td>✗</td><td>✗ ;</td></tr></table>	organelle	cell type			animal cells	plant cells	prokaryotic cells	nucleus	✓	✓	✗	large permanent vacuole	✗	✓	✗ ;	rough endoplasmic reticulum	✓	✓	✗ ;	Golgi body	✓	✓	✗ ;	centrioles	✓	✗	✗ ;	4
organelle	cell type																												
	animal cells	plant cells	prokaryotic cells																										
nucleus	✓	✓	✗																										
large permanent vacuole	✗	✓	✗ ;																										
rough endoplasmic reticulum	✓	✓	✗ ;																										
Golgi body	✓	✓	✗ ;																										
centrioles	✓	✗	✗ ;																										
1(b)(i)	microvilli ;	1																											
1(b)(ii)	site of aerobic respiration, so produces / provides, ATP ; A provides energy R produces energy use of ATP in context of absorption of digested food for, active transport / (idea of) absorption against a concentration gradient or endocytosis / pinocytosis; A bulk transport into cell(s) ;	2																											

Answer for Question 13 (9700_w24_22_2)

Question	Answer	Marks
2(a)	I protective gear / education about transmission / contact tracing / early diagnosis / testing any two from: practising safe sex / example ; A protected sex / using protection during sex A barrier contraceptives I use contraceptives screening blood, donated for / before, transfusions AW or not taking blood from high risk individuals / AW ; <i>idea of</i> treating donated blood (to inactivate viruses) ; A example e.g. heat / chemical treatment solvent-detergent treatment <i>in context of drug abusers</i> avoid sharing, needles / syringes / drug injecting equipment AW or use, new / sterile, needles / syringes / drug injecting equipment ; A cookers / sterile containers to mix drugs A use needle-exchange schemes / AW A use safe injection sites / AW avoid breast feeding / use baby milk products instead of breast milk ; pre-exposure prophylaxis / PrEP or post-exposure prophylaxis / PEP ; AVP ; e.g. using sterile equipment for, tattooing / surgery / dental procedures / body piercing	2
2(b)	the number of times larger an image is than actual ; AW I or smaller A formula stated in words A symbolised I/A <i>to support a weakly worded answer</i> A (<i>in context of describing an image</i>) enlargement / making larger / making bigger / increase in size / AW	1

Answer for Question 13 (9700_w24_22_2)

Question	Answer	Marks															
2(c)(i)	any one from: because bacteria have cell walls (only) of, murein / peptidoglycan ; because chitin is not found in bacterial cell walls ; A chitin / β-D-glucans, <u>main / major / AW</u> component of fungal cell walls	1															
2(c)(ii)	<table border="1"> <thead> <tr> <th>structural feature of <i>P. jirovecii</i></th><th>function</th><th>present (✓) or absent (x) in bacterial cells</th></tr> </thead> <tbody> <tr> <td>ribosomes</td><td>protein synthesis</td><td>✓</td></tr> <tr> <td>smooth endoplasmic reticulum</td><td>lipid / cholesterol / steroid, synthesis / metabolism AVP ; detoxification I carbohydrate metabolism</td><td>x</td></tr> <tr> <td>Golgi body</td><td>modification of proteins and lipids</td><td>x</td></tr> <tr> <td>mitochondrion / mitochondria</td><td>aerobic respiration</td><td>x</td></tr> </tbody> </table> one mark each correct column ;;; assume a tick that has been crossed is a cross ✕	structural feature of <i>P. jirovecii</i>	function	present (✓) or absent (x) in bacterial cells	ribosomes	protein synthesis	✓	smooth endoplasmic reticulum	lipid / cholesterol / steroid, synthesis / metabolism AVP ; detoxification I carbohydrate metabolism	x	Golgi body	modification of proteins and lipids	x	mitochondrion / mitochondria	aerobic respiration	x	3
structural feature of <i>P. jirovecii</i>	function	present (✓) or absent (x) in bacterial cells															
ribosomes	protein synthesis	✓															
smooth endoplasmic reticulum	lipid / cholesterol / steroid, synthesis / metabolism AVP ; detoxification I carbohydrate metabolism	x															
Golgi body	modification of proteins and lipids	x															
mitochondrion / mitochondria	aerobic respiration	x															

Answer for Question 13 (9700_w24_22_2)

Question	Answer	Marks
2(d)(i)	<i>allow squamous cells or squamous epithelial cells or epithelial cells for alveolar cells</i> <i>any two from:</i> 1 <i>gpA / (P. jirovecii) glycoprotein, <u>binds</u> to a, receptor / protein / glycoprotein on (surface of) alveolar cell</i> or <i>gpA <u>binds</u> to ECM, protein / glycoprotein ; I receptor</i> A <i>idea that ECM proteins are on, surface of / interacting with, (cell surface membrane of) alveolar cells</i> or <i>receptor / protein / glycoprotein on (surface of) alveolar cell is a binding site (for gpA) A same idea for ECM</i> 2 <i>(gpA) <u>complementary shape</u> ;</i> <i>allow ecf mp1 for gpA complementary shape to receptor on ECM</i> or <i>idea of complementary shape to attach / bind / adhere, to, alveolar cell / ECM</i> 3 <i>suggestion of adhering by, attractive charges / named bond types, between, gpA and, proteins / glycoproteins, on surface of alveolar cell / of ECM ;</i> 4 <i>AVP ; e.g. gpA acts as a <u>ligand</u></i>	2

Answer for Question 13 (9700_w24_22_2)

Question	Answer	Marks
2(d)(ii)	any three from: 1 alveolar cells / ECM, hindered / surrounded by / AW, <i>P. jirovecii</i> cells ; A alveolar wall becomes, thicker / AW 2 <u>diffusion</u> (of oxygen), impaired / decreased / AW ; A distance for <u>diffusion</u> increased A reduced surface area for <u>diffusion</u> ; 3 between, alveolus / alveolar air / alveolar space, and, capillary / blood / red blood cell(s) ; <i>allow mp if oxygen is clearly going in the correct direction</i> 4 less / AW, oxyhaemoglobin formed ; AW e.g. A less oxygen, binds to / taken up by / associates with, haemoglobin A less oxygen forms bonds with, Fe^{2+} / iron ion / iron, (in haemoglobin) 5 <i>idea of</i> ability of elastic fibres to, stretch / recoil, impaired / AW ; A <i>idea of</i> less elastic / decreased elasticity (of alveoli) 6 alveolar air not, refreshed / AW, so decreased diffusion gradient ; 7 AVP ; e.g. presence of macrophages hinders diffusion of oxygen <i>suggestion that P. jirovecii</i> infection, damages / AW, alveolar capillaries / venules / branches of pulmonary vein <i>suggestion that</i> oxygen used up for <i>P. jirovecii</i>, metabolism / activity / AW less ability of collagen to provide support to alveoli / AW	3

Answer for Question 13 (9700_w24_22_2)

Question	Answer	Marks
2(e)	any five from: caspofungin / drug, binds to site on, enzyme / glucan synthase, other than active site ; A binds to allosteric site changes shape of active site ; A enzyme changes, shape / tertiary structure, so active site is changed substrates cannot bind to active site / active site no longer complementary to substrates / enzyme-substrate complexes do not form ; A fewer enzyme-substrate complexes form less / no, (1,3- β-D) glucans / products, synthesised / produced ; cell wall, weakened / synthesis hindered / AW ; A cell wall not formed (leads to osmotic) lysis of, <i>P. jirovecii</i> / cell / fungus ; A bursting / cytolysis reduces / prevents, population growth ; AW e.g. decrease number of <i>P. jirovecii</i> A decreases ability of <i>P. jirovecii</i> to colonise / AW AVP ; e.g. <i>in context of lysis ref.</i> water entry into cell, by osmosis / down water potential gradient / AW (reduced number) increases chance of immune system eliminating the fungus	5

Answer for Question 14 (9700_w24_23_6)

Question	Answer	Marks
6(b)(i)	any one from: untreated / raw, sewage ; A poor sewage treatment / poor sewer system contaminated drinking water ; contaminated food / crops fertilised by raw sewage / seafood contaminated by raw sewage ; AVP ; e.g. newly arrived people infected with, <i>Vibrio cholerae</i> / cholera pathogen (e.g. UN troops in Haiti in 2010)	1
6(b)(ii)	cholera toxin is composed of more than one polypeptide ; A 6 / 7, polypeptides A amino acid chain A composed of, multiple / several, polypeptides	1
6(b)(iii)	glycolipid / glycoprotein ;	1
6(b)(iv)	ATP / adenosine triphosphate ; I adenine triphosphate	1
6(b)(v)	chloride ions decrease the <u>water potential</u> of, intestine lumen / outside of cells / AW ; A <u>lower</u> water potential A loss of chloride ions makes the, cytoplasm / the cells, have a less negative / higher, water potential (so water, leaves cell / enters lumen) by osmosis / down water potential gradient / from high to low water potential ;	2

Answer for Question 15 (9700_m23_22_1)

Question	Answer	Marks															
1(a)	<table border="1"> <thead> <tr> <th>cell structure</th><th>eukaryotic cells</th><th>prokaryotic cells</th></tr> </thead> <tbody> <tr> <td>nucleus</td><td>✓</td><td>✗</td></tr> <tr> <td>Golgi body</td><td>✓</td><td>✗</td></tr> <tr> <td>circular DNA</td><td>✓</td><td>✓</td></tr> <tr> <td>70S ribosome</td><td>✓</td><td>✓</td></tr> </tbody> </table> one mark for each correct column ; ;	cell structure	eukaryotic cells	prokaryotic cells	nucleus	✓	✗	Golgi body	✓	✗	circular DNA	✓	✓	70S ribosome	✓	✓	2
cell structure	eukaryotic cells	prokaryotic cells															
nucleus	✓	✗															
Golgi body	✓	✗															
circular DNA	✓	✓															
70S ribosome	✓	✓															
1(b)	<i>diagram showing:</i> dark line(s) labelled as phosphate heads ; A phospholipid heads clear area(s) between pairs of dark lines labelled as, fatty acid tails / hydrocarbon chains / hydrophobic core / AW ; R if pointing to intercellular space clear area between the two cell surface membranes labelled as, interstitial fluid / tissue fluid / extracellular matrix / intercellular space ; A intercellular, area / region	3															

Answer for Question 15 (9700_m23_22_1)

Question	Answer	Marks
1(c)(i)	<i>G₁ phase:</i> <i>any one from:</i> RNA, synthesised / transcribed / translated ; proteins / enzymes, synthesised ; increasing quantity of organelles ; increase in volume of cytoplasm ; A growth (at end of <i>G₁</i> phase) checkpoint passed for dividing or not ; <i>S phase:</i> <i>any one from:</i> DNA (semi-conservative) replication ; doubles, mass / number of strands, of DNA ; ref. to each chromosome now comprises two chromatids ;	2
1(c)(ii)	<i>any one from:</i> uncontrolled / increased, cell division / mitosis ; resting cells could enter mitosis ; more cells move from the <i>G₁</i> to the S phase ;	1

Answer for Question 16 (9700_s23_21_1)

Question	Answer	Marks																							
1(a)(i)	any one from: <u>no chloroplasts</u> (present) ; presence of (many) small vacuoles / no large vacuole / no central vacuole ; central nucleus or nucleus not located at the, edge / periphery ;	1																							
1(a)(ii)	one mark per row ;;; If 0 marks, allow 1 mark if name of cell structure column completed correctly <table border="1"> <thead> <tr> <th>function</th><th>name of cell structure</th><th>letter on Fig.1.1</th></tr> </thead> <tbody> <tr> <td rowspan="2">gas exchange</td><td>cell <u>surface</u> membrane I phospholipid bilayer</td><td>A</td></tr> <tr> <td>mitochondrial membrane(s)</td><td>E</td></tr> <tr> <td>production of subunits of ribosomes</td><td>nucleolus / nucleoli</td><td>C</td></tr> <tr> <td rowspan="4">active transport of ions</td><td>cell <u>surface</u> membrane ecf for cell membrane</td><td>A</td></tr> <tr> <td>or tonoplast / vacuolar membrane</td><td>F</td></tr> <tr> <td>or mitochondrial membrane(s)</td><td>E</td></tr> <tr> <td>or nuclear envelope A nuclear membrane(s)</td><td>B</td></tr> <tr> <td>aerobic respiration</td><td>mitochondrion / mitochondria</td><td>E</td></tr> </tbody> </table>	function	name of cell structure	letter on Fig.1.1	gas exchange	cell <u>surface</u> membrane I phospholipid bilayer	A	mitochondrial membrane(s)	E	production of subunits of ribosomes	nucleolus / nucleoli	C	active transport of ions	cell <u>surface</u> membrane ecf for cell membrane	A	or tonoplast / vacuolar membrane	F	or mitochondrial membrane(s)	E	or nuclear envelope A nuclear membrane(s)	B	aerobic respiration	mitochondrion / mitochondria	E	4
function	name of cell structure	letter on Fig.1.1																							
gas exchange	cell <u>surface</u> membrane I phospholipid bilayer	A																							
	mitochondrial membrane(s)	E																							
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	or mitochondrial membrane(s)	E																							
	or nuclear envelope A nuclear membrane(s)	B																							
aerobic respiration	mitochondrion / mitochondria	E																							
1(b)(i)	endocytosis / pinocytosis ; R phagocytosis	1																							

Answer for Question 16 (9700_s23_21_1)

Question	Answer	Marks
1(b)(ii)	any three from: 1 <u>hydrolysis</u> / use water to break bonds ; A ref. to hydrolytic enzymes 2 (action of) protease(s) / peptidases / proteolytic enzyme(s) ; 3 peptide bonds broken ; R if part of a list with other bonds not found in proteins, such as glycosidic, ester, phosphodiester 4 to form, peptides / amino acids ;	3
1(c)	1 formation of phagolysosomes / described ; A fusion with, phagosomes / phagocytic vesicle or vacuole 2 breakdown / digestion, of, pathogen / bacteria / microorganisms / AW ; A kill / destroy, pathogen / bacteria / microorganisms / AW one from: 3 (by) two named enzymes ; e.g. lysozyme, protease, lipase, carbohydrase, nuclease 4 any two named substrates that are hydrolysed ; e.g. polysaccharides, peptidoglycans, proteins, lipids, glycogen, nucleic acid(s) 5 to form, harmless / useful / soluble / AW, products ; I ref. to breakdown of organelles	2

Answer for Question 17 (9700_s23_22_4)

Question	Answer	Marks
4(a)(i)	 label line to any part of nucleolus ; <i>must touch an area of nucleolus</i>	1
4(a)(ii)	any two from: - suggestion for structure as a flagellum ; R microvillus A cilium / undulipodium - presence of microtubules ; - presence of 9 + 2 (microtubule) arrangement / pattern, (in cross section) ; - AVP ; e.g. <i>ref. to location on outer part of cell (so can move)</i> / AW - circular cross section suggests tubular structure (hence flagellum) / AW - e.g. looks cylindrical	2

Answer for Question 17 (9700_s23_22_4)

Question	Answer	Marks
4(a)(iii)	any three from: eukaryote because presence of (true) nucleus / nuclear envelope / nuclear membranes ; mitochondrion ; <i>if mp1 and 2 not gained, allow double membrane-bound structures</i> nucleolus ; chromatin ; (X) has 9+2 pattern of microtubules ; A ref. to cytoskeleton / microtubules X / AW, covered by cell (surface) membrane ; <u>endoplasmic reticulum</u> ; I rough / smooth I ER / SER / RER A Golgi body not prokaryote because absence of cell wall ; I does not have peptidoglycan cell wall (size) greater than 5 µm ; A larger than (typical) prokaryote / bacterial cell A valid calculated size using scale bar <i>if stated as a prokaryote, read whole response and if all ideas refer correctly to eukaryotic structures, allow max 1</i>	3
4(b)(i)	pathogen ; I parasite	1
4(b)(ii)	falciparum / malariae / ovale / vivax ; A knowlesi correct spelling	1

Answer for Question 17 (9700_s23_22_4)

Question	Answer	Marks
4(c)	any three from: <i>similarities</i> <u>vector</u>, qualified ; e.g. <u>vector</u> is, an insect / a fly both, are <u>vector</u>-borne / are carried by a <u>vector</u> both, need / involve, a <u>vector</u> (vector / carrier / insect) feeds / AW, on (human) blood ; A both diseases transmitted through blood <i>differences</i> <i>malaria</i> (vector) is, a mosquito / <i>Anopheles</i> ; ora (tsetse fly) not a mosquito R mosquito / <i>Anopheles</i>, versus insect (only) female (<i>mosquitos</i>), feed on blood / transmit disease / are vectors ; <i>(information given for sleeping sickness is that male and female tsetse flies feed on blood)</i>	3

Answer for Question 18 (9700_s23_23_3)

Question	Answer	Marks
3(a)(i)	X neutrophil ; Y monocyte ; A lymphocyte I B– / T–	2
3(a)(ii)	(magnification) = $\frac{\text{image / line Z, length / width}}{\text{actual width}}$; A (M) = I / A A magnification triangle (x) 1500 ; A 1375 (for 11 mm) / 1438 (for 11.5 mm)	2

Question	Answer	Marks
3(b)(i)	<i>any four from:</i> 1 (carbonic anhydrase) catalyses the reaction between CO ₂ and H ₂ O ; AW 2 to form, carbonic acid / H ₂ CO ₃ ; 3 H ⁺ forms (together with HCO ₃ ⁻ from dissociation of H ₂ CO ₃) ; 4 H ⁺ binds to haemoglobin to form haemoglobinic acid ; 5 displacing / releasing, oxygen from haemoglobin ; 6 allosteric effect / change in tertiary structure / AW, in (oxy)haemoglobin (causes release of oxygen) ;	4
3(b)(ii)	curve below the original line ; curve, merging / will merge, with the original line after it begins to plateau ;	2

Answer for Question 19 (9700_s23_23_2)

Question	Answer	Marks
2(a)(i)	<i>max two if, number of (reported) cases / AW, not stated any three from:</i> 1 overall decrease in number of reported cases from 1980 to 2000 / over the time period / AW ; 2 from, 27 600 / 27 700 / 27 800, to, 16 300 / 16 400, cases ; <i>A manipulated data e.g. decline of, 11 200 / 11 300 / 11 400 / 11 500 cases</i> 3, 4 additional trends ;; e.g. decrease from 1980 to 1984 increase between 1988 and 1992 or (overall) increase between 1984 to 1992 decrease after 1992 (to 2000) little change / slight increase and decrease / AW, between 1984 and 1988 5 use of comparative values from Fig. 2.1 to support mps, 3 / 4 ;	3
2(a)(ii)	HIV-infected people may develop a weak(ened) immune system or people with, HIV/AIDS have a weak(ened) immune system ; <i>A poor immune response</i> <i>A idea of more susceptible to disease caused by, <i>Mycobacterium, tuberculosis / bovis</i></i> <i>A TB is an opportunistic disease (of people with HIV/AIDS)</i> increased risk of latent TB becoming active in (many) people, living with HIV / with HIV/AIDS ; AW detail of weak immune system ; e.g. decrease in number of ,T-lymphocytes / T helper cells poor, humoral / B-lymphocyte, response AVP ; <i>idea of more cases of TB owing to more people infected with HIV increases risk of spreading to uninfected people</i>	2

Answer for Question 19 (9700_s23_23_2)

Question	Answer	Marks
2(b)	<i>any two from:</i> 1 prescribe / take, antibiotics, only when (absolutely) necessary ; A examples e.g. do not use for viral infections do not use as preventative medicine 2 make sure, correct / effective, antibiotic(s), prescribed / used AW A ref. to, broad spectrum / narrow spectrum, antibiotics, qualified or make sure people take the correct dose or complete course / follow instructions for use, of antibiotics A ref. to DOTS ; 3 develop new, antibiotics / antibacterials ; 4 use other antibacterials ; <i>if mp3 and 4 not gained, allow one mark for vary antibiotic treatment or use a number of different antibiotics at the same time</i> 5 (named) measures to, prevent infection / break transmission cycle (to reduce the need for antibiotic use) ; e.g. vaccines good hygiene in hospitals quarantine people who have multi-drug resistant bacterial infections 6 report, cases / patterns, of antibiotic resistance ; 7 reduce / control, antibiotics in, agriculture / animals used for food ; 8 <i>ref. to</i> education for, healthcare professionals / public, to reduce impact of antibiotic resistance ; 9 AVP ; e.g. <i>ref. to</i> monitoring situation to check if antibiotic is effective WHO Global Plan to End TB	2
2(c)(i)	(bronchi) may, collapse / lose (structural) support ;	1

Answer for Question 19 (9700_s23_23_2)

Question	Answer	Marks																				
2(c)(ii)	one mark each correct <u>column</u> = 3 marks ;;; if 0 or 1 mark gained, check for correct row to max 2 <i>In the whole table:</i> • <i>if only ticks are used, assume blanks are crosses</i> • <i>if only crosses are used, assume blanks are ticks</i> <i>If there are ticks <u>and</u> crosses and blanks in the whole table, R the columns or rows with the blank(s)</i> <table><tr><th>cell type</th><th>alveolus</th><th>bronchus</th><th>trachea</th></tr><tr><td>ciliated epithelial cell</td><td>×</td><td>✓</td><td>✓</td></tr><tr><td>goblet cell</td><td>×</td><td>✓</td><td>✓</td></tr><tr><td>smooth muscle cell</td><td>×</td><td>✓</td><td>✓</td></tr><tr><td>squamous epithelial cell</td><td>✓</td><td>×</td><td>×</td></tr></table>	cell type	alveolus	bronchus	trachea	ciliated epithelial cell	×	✓	✓	goblet cell	×	✓	✓	smooth muscle cell	×	✓	✓	squamous epithelial cell	✓	×	×	3
cell type	alveolus	bronchus	trachea																			
ciliated epithelial cell	×	✓	✓																			
goblet cell	×	✓	✓																			
smooth muscle cell	×	✓	✓																			
squamous epithelial cell	✓	×	×																			

Answer for Question 20 (9700_w23_21_5)

Question	Answer	Marks
5(a)(i)	cartilage ;	1
5(a)(ii)	<i>any two from:</i> (smooth muscle) contracts (and relaxes) / contractile ; R bronchus contracts changes diameter of the airway / controls size of the lumen ; A <i>ref. to</i> constriction of bronchus (may) help to regulate airflow, into / away from, gas exchange surfaces ; AVP ;	2
5(b)(i)	phospholipid with a head and two tails ; bilayer shown ;	2

Answer for Question 20 (9700_w23_21_5)

Question	Answer	Marks
5(b)(ii)	<i>any two from:</i> cholesterol regulates the fluidity of the membrane ; membrane less able to fuse with the lamellar body ; AVP ;	2
5(b)(iii)	<i>any one from:</i> prevents too much surfactant building up in the lungs ; (digest surfactant to) recycle / reuse, molecules in surfactant ; engulf, pathogens / microbes / AW, trapped in surfactant ; macrophages use, protein / phospholipid / cholesterol, in surfactant ; AVP ;	1

Answer for Question 21 (9700_w23_21_2)

Question	Answer	Marks
2(a)	X (nucleolus) synthesis / AW of, ribosomal subunits / ribosomes ; A synthesis of organelles that are the sites of protein synthesis Y (chromatin) contains gene(s), coding for the polypeptide(s) / AW ; A site, of transcription / for production of mRNA	2
2(b)(i)	primary ;	1
2(b)(ii)	any one from: carboxylic acid / carboxyl, group ; A both have C=O contain carbon / hydrogen / oxygen ;	1

Answer for Question 21 (9700_w23_21_2)

Question	Answer	Marks
2(b)(iii)	any three from: ref. to role in / forms part of, overall 3D shape ; A tertiary / quaternary structure A forms part of hydrophobic region of ghrelin allows ghrelin to bind to receptor ; allows, ghrelin / part of ghrelin, to have a complementary shape / be complementary (to the receptor) ; A description suggested detail ; e.g. interacts with hydrophobic region of the receptor molecule (for binding) AVP ; e.g. help interaction with / embeds in, hydrophobic portion of the cell surface membrane <i>in context of bringing a complementary part of the molecule closer to receptor for binding</i> suggestion that fatty acid chain allowed, incorporation into / attachment to, a transport molecule in plasma to reach target cell ref. to effect of binding triggering reactions inside the cell ;	3
2(c)(i)	1.8% ; working ; $\frac{30 \times 3}{5000} \times 100$ codons for 29 amino acids (including start met) and a stop codon allow 1 mark if only 28 or 29 instead of 30, so 1.7% answer obtained	2

Answer for Question 21 (9700_w23_21_2)

Question	Answer	Marks
2(c)(ii)	any two from: introns / non-coding regions, removed / AW ; exons / coding regions, are joined together ; gene splicing / RNA splicing ; R DNA splicing AVP ; e.g. guanine (cap) added (to 5' end) poly A tail / many As, added (to 3' end)	2

Answer for Question 22 (9700_w23_22_3)

Question	Answer	Marks
3(a)	<u>aorta</u> / dorsal aorta ; <i>correct spelling needed</i>	1
3(b)(i)	any one from: <i>context is using gaps for movement between, hepatocyte / tissue fluid, and, blood / sinusoid</i> I ref. to red blood cells I shorter diffusion, distance / pathway higher rate of / easier for / AW, exchange / movement / AW, of substances ; A named substances / nutrients substances do not have to cross, a cell layer / into and out of endothelial cells ; larger molecules / plasma proteins, can pass through ; Kupffer cells can pass through (into tissue fluid) ; AW A ref. to other phagocytic cells R Kupffer cells can diffuse through R if stated as entering hepatocytes	1

Answer for Question 22 (9700_w23_22_3)

Question	Answer	Marks
3(b)(ii)	<i>max 3 if described as phagocytosis of a pathogen rather than a red blood cell</i> <i>allow rbc for red blood cell</i> <i>any four from:</i> 1 endocytosis / phagocytosis ; 2 described ; e.g. red blood cell, engulfed / enveloped pseudopodia surround red blood cell <i>max three from</i> 3 forms (phagocytic) vacuole / (phagocytic) vesicle / phagosome ; 4 lysosome fuses (with phagosome) ; AW merges / joins to / combines with I attaches / binds to 5 (lysosome contains) hydrolytic / digestive, enzymes ; A hydrolases / named examples 6 digestion to produce haem and globin ; A amino acids for globin 7 AVP ; e.g. suggestion of, detection / recognition, of red blood cell	4

Answer for Question 22 (9700_w23_22_3)

Question	Answer	Marks
3(c)(i)	any three from: I Golgi body / lysosome / vesicle <i>mp1 and mp2 complete term needed either in the text or labelled</i> 1 <u>smooth endoplasmic reticulum</u> labelled on Fig. 3.2 and detail ; e.g. for, lipid / triglyceride / cholesterol, synthesis tubular appearance / no ribosomes 2 <u>rough endoplasmic reticulum</u> labelled on Fig. 3.2 and detail ; e.g. for protein, synthesis / AW A for enzyme synthesis flattened (sac) appearance ribosomes A ribosome(s) labelled <u>and</u> for (plasma) protein synthesis 3 mitochondrion labelled on Fig. 3.2 <u>and</u> detail ; e.g. many mitochondria for (aerobic) respiration produce ATP / provide energy, (for hepatocyte reactions) R generate / make, energy double membrane / presence of cristae <i>allow if one mitochondrion is correctly labelled and one of the 'circular' mitochondria has a different label e.g lysosome</i> 4 presence of glycogen granule(s) as, energy / glucose, store ; A releases / provides, glucose 5 presence of lipid droplet(s), as energy store ; A provides fatty acids A provides components for cholesterol synthesis <i>penalise once (from mp1, 2, or 3) if diagram not labelled but structures named correctly and correct detail given</i>	

Answer for Question 22 (9700_w23_22_3)

Question	Answer	Marks
3(c)(ii)	any one from: I ref. to staining or size mitochondrion, bound by / has, double membrane / two membranes ; I peroxisome has (only) one membrane peroxisome no cristae / mitochondrion has cristae ; R cisternae peroxisome spherical shape <u>and</u> mitochondria, different shapes / AW ; I if only peroxisome shape stated A circular for spherical A description e.g. 'sausage' shape	1
3(c)(iii)	any two from: mitochondrion (ora for peroxisomes) has, DNA / genes (coding for enzymes) ; R linear DNA A genetic, material / information, qualified with, transcription / ref. to mRNA / coding for enzymes (70S) ribosomes (site of enzyme synthesis) ; R 80S ribosomes has the enzymes for, transcription / translation, (to synthesise enzymes) ; can produce ATP (for enzyme synthesis) ; R produce energy I has ATP AVP ; ; other suggestions e.g. has (chaperone) proteins involved in, folding / formation of tertiary structure ATP cannot enter peroxisome to provide energy source peroxisome has enzymes that cause degradation of, one / or more, substance(s) involved in protein synthesis	2

Answer for Question 22 (9700_w23_22_3)

Question	Answer	Marks
3(c)(iv)	any two from: (peroxisome) membrane bound, so rest of cell protected (from hydrogen peroxide) ; A hydrogen peroxide can have toxic effects on (rest of) cell / AW (peroxisome) acts as a compartment / specific area / contained, for, more efficient breakdown of hydrogen peroxide / control of reactions ; high concentration of enzyme in one location ; A more enzyme-substrate complexes can form provides, optimum / AW, conditions, for (other peroxisome) reactions ; production of oxygen as by-product, so useful for, peroxisome reactions requiring oxygen / mitochondrial function / aerobic respiration ; AVP ; e.g. isolates (peroxisomes) enzymes from rest of cell	2

Answer for Question 23 (9700_w23_23_4)

Question	Answer	Marks
4(a)(i)	RNA polymerase ;	1
4(a)(ii)	phosphodiester ;	1
4(b)(i)	5 ;	1
4(b)(ii)	any two from: 1 other strand is not the <u>template</u> strand / only the <u>template</u> strand is transcribed ; 2 (if transcribed) sequence of, nucleotides / bases, in (m)RNA codes for a different sequence of amino acids ; A sequence of codons A primary transcript for RNA 3 (if transcribed) results in a non-functional polypeptide / AW ; A codes for a polypeptide with different function 4 translation would be a waste of energy / translation will not occur (as no signalling sequence) ; 5 any suggestion of a possible consequence to structure of collagen ; 6 (m)RNA is single stranded ; 7 AVP ; e.g. RNA polymerase synthesises RNA in the 5' to 3' direction	2
4(c)(i)	ref. to (mitochondrial) envelope / two membranes / double membrane / inner membrane and outer membrane ; R cell or cell surface membrane inner membrane is folded / crista(e) ; (70S) ribosomes ; R 80S ribosomes (mitochondrial) matrix ; I DNA	2
4(c)(ii)	0.6 (μm) ; R 0.60 (only one significant figure required)	1

Answer for Question 23 (9700_w23_23_4)

Question	Answer	Marks
4(d)	any three from: 1 active transport, uses ATP / moves (ions) against concentration gradient ; 2 facilitated diffusion, passive / no ATP / no energy / with the gradient / down concentration gradient ; 3 protein, carrier / pump, changes shape / <i>ref. to</i> conformation change / has binding site(s) ; 4 channel protein / pore protein, for facilitated diffusion (only) ; I carrier protein 5 AVP ; e.g. <i>ref. to</i> ionophore(s) / hydrophilic pore in channel proteins / specificity of carrier or channel protein(s) <i>if mp1 and mp2 are not awarded allow one mark for naming active transport <u>and</u> facilitated diffusion</i>	3

Answer for Question 24 (9700_m22_22_4)

Question	Answer	Marks
4(a)	! any part of the pathway beyond cortical cells ! incorrect mechanisms any four from: 1 correct ref. to, apoplastic pathway <u>and</u> symplastic pathway / apoplast <u>and</u> symplast ; 2 cell wall route ; 3 further detail ; e.g. between, cellulose fibres / spaces between cells does not cross (cell) membranes 4 entry into, root hair cell by, crossing (partially permeable) cell surface membrane / osmosis ; 5 (then) cytoplasmic route / within cytoplasm ; 6 from cell to cell via plasmodesmata ; 7 vacuolar route ; A crosses, tonoplast / vacuolar membrane	4
4(b)	any one from: for active transport of mineral ions ; A for mineral ion uptake against a concentration gradient for, ATP / energy, for active transport ;	1

Answer for Question 25 (9700_s22_21_1)

Question	Answer	Marks
1(a)	A – ciliated, epithelium / epithelial tissue ; B – smooth muscle ; D – cartilage ;	3
1(b)	1 produce / release / secrete, mucus / mucin ; R excrete mucus <i>any two from:</i> 2 mucus forms a layer over the (ciliated) epithelium ; 3 traps / sticks to, bacteria / viruses / pathogens / microorganisms / dust / pollen / (fungal) spores / AW ; 4 mucus is, moved / AW, away from alveoli or lung tissue / towards back of mouth / AW, by cilia ; R 'by ciliated cells' 5 <i>idea that</i> mucus prevents (named) pathogens reaching, epithelial cells / alveoli / gas exchange surface ; A acts as a barrier to (named) pathogens	3
1(c)(i)	$pH\ 7.7 = 72(\%)$ $pH\ 7.4 = 60(\%)$;	1
1(c)(ii)	<i>allow Hb or hb for haemoglobin</i> decrease in supply of oxygen to tissues / AW ; (at lower pCO_2 / increase pH blood) affinity of, haemoglobin, for oxygen is higher or haemoglobin is more saturated ora A less oxygen, released / dissociates / AW, from haemoglobin (than normal) <i>must be in context of higher affinity in the tissues</i> or data quote for difference in saturation of haemoglobin in correct range of pO_2 (within 2–6 kPaO ₂) ;	2

Answer for Question 26 (9700_s22_21_5)

Question	Answer	Marks
5(a)	(pathogen / causative organism is) transferred / passed on / AW, (from infected) to an uninfected, person / organism ; I disease I from one person to another <i>unqualified</i> I spread	1
5(b)	any two from <i>information needed</i> 1 magnification of, image / (electron) micrograph / Fig. 5.1 ; A scale bar I magnification of (electron) microscope 2 length of flagellum (in, image / Fig. 5.1) ; I width / diameter / size 3 <i>formula</i> actual length of flagellum = measured length of flagellum divided by magnification ; A $A = I / M$ or magnification triangle	2
5(c)(i)	<u>0.2</u>	1

Answer for Question 26 (9700_s22_21_5)

Question	Answer	Marks
5(c)(ii)	<i>large outbreaks of cholera in countries shown in Table 5.1 accept ora</i> any five from: 1 <i>ref. to poverty, unqualified</i> 1 civil disturbance / (civil) war ; 2 named natural disaster ; 1 famine / drought 3 lack of, uncontaminated / AW, drinking water ; A examples e.g. no piped water supply / no bottled water / no water treatment 4 <i>ref. to sewage, qualified ;</i> e.g. no sewage treatment A examples e.g. no separation of drainage from homes and water supplies / contamination of water supplies with human faeces 5 poor sanitation ; <i>credit only if mp3 or mp4 are not awarded</i> 6 <i>ref. to poor personal hygiene / described example ;</i> 7 eating contaminated foods ; e.g. crops irrigated with contaminated water / seafood harvested from contaminated seawater 8 slow(er) / no / little, diagnosis ; 9 slow(er) / no / little, treatment / healthcare / medical facilities ; 10 <u>oral</u> rehydration, (salts / therapy), not, provided / available ; A named example of oral rehydration 11 antibiotics not, provided / available ; 12 vaccine not provided / vaccine not available / reluctance to be vaccinated / ref to anti-vaccination campaigns ; 13 poor, understanding of / education about, prevention / treatment / precautions ; 14 AVP ; e.g. difficult to reach people living in, rural / remote / dangerous, areas lack of trained professionals antibiotic resistance <i>ref. to people bringing in cholera from elsewhere</i>	5

Answer for Question 27 (9700_s22_21_2)

Question	Answer		Marks
2(a)(i)	exocytosis ;		1
2(a)(ii)	one mark per row		4
	cell structure in Fig. 2.1	name of cell structure	function of cell structure in plasma cell
	P	nucleolus	production / assembly, of (sub-units of) ribosomes ; A manufacture, ribosomal RNA / rRNA / transfer RNA / tRNA
	Q	mitochondrion	R if answer refers to, ATP / energy, <u>for</u> aerobic respiration <u>aerobic respiration</u> ; A oxidative phosphorylation A provide, ATP / energy A produce / AW, <u>ATP</u>
	R	rough endoplasmic reticulum R rough ER / RER / ribosome	protein / antibody, synthesis / transport ; A synthesis of, polypeptide(s) / heavy and light chains A (post-translational) modification of, polypeptide / protein / antibody <i>allow example</i> A forms (transport) vesicles
	S	Golgi body A Golgi, complex / apparatus	I lipids (post-translational) modification of, polypeptide / protein / antibody <i>allow example</i> or packaging, qualified ; e.g. packaging of antibodies / protein, into vesicles A formation of, vesicles / (primary) lysosomes

Answer for Question 27 (9700_s22_21_2)

Question	Answer	Marks
2(b)	any three from: 1 (named) small mammal, injected / AW, with antigen ; 2 immune response occurs (over several weeks) ; A immune response described 3 plasma cells / B-lymphocytes / B-cells / splenocytes, extracted from spleen ; 4 plasma cells / activated B-lymphocytes / activated B-cells, <u>fused</u> with, myeloma / tumour / cancer / AW, cells (to form hybridomas) ; 5 AVP ; e.g. hybridoma cells separated (into wells) to produce clones screening / selection / AW, for hybridomas producing desired, (monoclonal) antibodies / Mabs <i>ref. to large scale production</i>	3
2(c)	any four from: 1 (artificial) <u>passive immunity</u> ; R natural 2 no immune response ; I primary / secondary 3 <i>idea that</i> antibodies are, broken down / degraded / destroyed (in the body / blood) ; R 'antibodies die' 4 no long-term / only short-term / only temporary, immunity ; A no formation of immunological memory 5 memory cells not produced ; A memory cells only produced, in active immunity / during an immune response / after presentation of antigen 6 AVP ; e.g. <i>ref. to</i> no, clonal selection / clonal expansion / antibodies produced	4

Answer for Question 28 (9700_s22_22_5)

Question	Answer	Marks
5(a)	<i>any one from:</i> I too small presence of cilia ; A ciliated, cells / epithelial cells / epithelium AVP ; e.g. <i>suggestion that</i> mucus on surface makes detail not easily seen	1
5(b)	epithelium has goblet cells and ciliated epithelial cells ; A ciliated cells A two different cell types present I ref. to cell division ref. to staining ; e.g. use of stains gives different, shades / colours differential staining one cell type more neutral / acidic different parts of cells stain differently idea of cells have different densities ; e.g. <i>idea of</i> more structures / larger nucleus, gives greater density / AW R no cell structures <i>for lighter cell</i> I ref. to number of cilia (sectioning may include) more of nucleus so, affects light penetration / makes cell darker ora AVP ; <i>idea of</i> different components in cells appearing, darker / lighter	2

Answer for Question 28 (9700_s22_22_5)

Question	Answer			Marks
5(c)	any three from:			3
	A		B / cartilage	
	max two for structure			
	smooth muscle / composed of smooth muscle cells or no chondrocytes	or	no smooth muscle cells or has chondrocytes ;	
	cells close together	or	cells, (more) isolated / in gaps / in lacunae ;	
	cells, spindle shaped / elongated / AW	or	cells (more) rounded / AW ;	
	AVP structure e.g. not surrounded by, perichondrium / AW contains blood vessels	or	surrounded by, perichondrium / AW no blood vessels ;	
	function			
	contractile / contracts (and relaxes) I recoil A bronchi walls contract R bronchi contract	or	non-contractile ;	
	changes diameter of airways A controls size of lumen	or	protective / support ; A described e.g. prevents collapse of, bronchus or keeps bronchus open	
if incorrectly quotes A as the cartilage, use right hand column to allow one mark max (ecf)				

Answer for Question 29 (9700_s22_22_1)

Question	Answer	Marks
1(a)	I ref. to resolution any <i>one</i> from: Fig. 1.1A is scanning (EM), qualified ; e.g. shows, surface / contour / 3-D, views shows (only the), the outer / external, view (of microvilli) idea of good focus with different depths does not have stated feature of TEM (see mp2) Fig. 1.1B is transmission (EM), qualified ; e.g. showing, 2D / flat, views (of, microvilli / mitochondria) image in one plane showing section through, mitochondria / microvilli / cell I thin shows, internal view of cell / contents of cell / AW does not have stated feature of SEM (see mp1) scanning (EM) stated plus feature <u>and</u> transmission (EM) stated plus feature } ; if Fig. 1.1, A / B not identified	1
1(b)	any <i>two</i> from: max 1 if stating to measure one of the sides of the figure (for each image) measure a number of microvilli and calculate a mean ; same units for actual and measured images / example given ; e.g. <i>if microvillus measurement is in mm</i> convert, microvillus measured length to μm / actual length to mm R if extra detail given is incorrect e.g. <u>divide</u> by 1000 for mm to μm divide, microvillus / image, length by, actual length / AW / $1(\mu\text{m})$; A <i>idea that</i> value for, microvillus / image, length is the magnification	2
1(c)(i)	any <i>two</i> from: (movement of substances) against concentration gradient / from low(er) to high(er) concentration ; (protein has) binding site(s) ; specific ; A description e.g. shape complementary to shape of substance <i>can be in context of protein or binding site</i> <i>ref. to</i> (binding causes protein), conformational change / change of shape ;	2

Answer for Question 29 (9700_s22_22_1)

Question	Answer	Marks
1(c)(ii)	<i>any two from:</i> 1 glucose is moving against a (concentration) gradient ; AW e.g. low to high 2 movement powered by inward movement of Na⁺ ; AW 3 Na⁺ movement (into cell from gut lumen) down an electrochemical gradient or down a (Na⁺), concentration / diffusion, gradient or by facilitated diffusion ; A diffusion if response includes <i>ref. to</i> the cotransport protein / cotransporter 4 AVP ; e.g. <i>idea that</i>, cotransport needed so that <u>all</u> glucose will be removed from gut lumen or a facilitated diffusion of glucose will only be to equilibrium / AW cotransporter has (specific) binding site for glucose I cotransporter has a complementary shape <i>idea that</i> there is no specific active uptake protein for glucose	2
1(c)(iii)	increases / larger / large, surface area (over which glucose can enter cell per unit time) ; A increases / higher / high, SA:V <i>idea of</i> (so) more, transport / carrier / cotransport, proteins A more cotransporters or more proteins, located in membrane / AW ; R pump proteins A <i>idea of</i> more space / places, where proteins can transport glucose	2

Answer for Question 29 (9700_s22_22_1)

Question	Answer		Marks
1(d)	any four from:		4
	suggestion max 3	explanation	
	1 to replace, old / dead / damaged / injured, cells or to, repair / replace, damaged tissue ; I repair cells I replace old tissues	6 idea of <u>function</u> in context of mp1 or 2 or 3 ; e.g. repair allows tissues to function specialisation / differentiation, allows, cells / tissue, to function genetically identical so cells can function as a tissue look for other approaches e.g. 'replace damaged cells that no longer function' is mp1 and mp6 7 detail of function (intestines) ; e.g. absorption (of, glucose / nutrients) production of digestive enzymes pass absorbed, nutrients / AW, to blood I nutrition	
	2 cells are produced that can, differentiate / become specialised (into intestinal cells); I multipotent / AW R if, stated / strongly implied that, <u>all</u> cells produced by mitosis become specialised		
	3 produce cells that are genetically identical ; A clones A identical / same, DNA / genetic material / genetic information		
	4 growth ; R growth of cells	8 idea of development during, infancy / childhood ;	
5 renew / replenish / restore number of / AW, stem cells ; I increase in stem cells	9 for, continued production / constant supply / AW, of intestinal cells or so that number of stem cells doesn't decrease ;		

Answer for Question 30 (9700_s22_23_1)

Question	Answer			Marks
1(a)	bronchi ; A bronchus			1
1(b)	<i>any two from:</i> <i>trachea v alveoli</i>			2
	<i>trachea</i>		<i>alveoli</i>	
	(carries) oxygenated blood A (carries) blood with more oxygen	or	(carries) deoxygenated blood ; A described A (carries) blood with, less / little, oxygen I no oxygen	
	lower concentration of carbon dioxide	or	higher concentration of carbon dioxide ;	
	blood at higher pressure	or	blood at lower pressure ;	
	(part of the) systemic circulation or branch from the aorta / (originates) from, left ventricle	v	(part of the) pulmonary circulation or pulmonary artery or from right ventricle (of heart) ;	

Answer for Question 30 (9700_s22_23_1)

Question	Answer	Marks
1(c)(i)	<i>allow from, labelled / annotated, diagrams drawn</i> <i>any three from:</i> ciliated epithelium / ciliated epithelial cells / ciliated cells / cells with cilia ; detail (of ciliated epithelial cells) ; e.g. columnar / description cilia, only facing the lumen / on apical lumen / lining the lumen on surface of tissue goblet cells ; AVP ; e.g. basement membrane pseudostratified (epithelium) large nuclei visible / clear, nuclei basal nuclei (in goblet cells) nucleoli visible within nuclei	3

Answer for Question 30 (9700_s22_23_1)

Question	Answer	Marks
1(c)(ii)	blood vessel / capillary / venule ; <i>plus two from:</i> presence of red blood cells (in the lumen) ; endothelium / endothelial cells ; A flat cells <i>accept for endothelial cell</i> A cells with, prominent / bulging / AW, nucleus very thin / one cell thick, walls ; <i>ref. to</i> small size, qualified ; e.g. narrow lumen / comparison to other tissues <i>alternative</i> endothelium / endothelial cell ; <i>plus two from</i> flat cells ; cells with, prominent / bulging / AW, nucleus ; one cell thick ;	3

Answer for Question 31 (9700_s22_23_4)

Question	Answer	Marks
4(a)	<u>image length</u> ; A magnification triangle magnification 250 (nm) ; (8 mm) A 220 (for 7 mm) A 230 (for 7.5 mm) A 270 (for 8.5 mm) A 280 (for 9 mm)	2
4(b)	pathogen ;	1

Answer for Question 31 (9700_s22_23_4)

Question	Answer	Marks
4(c)	ingests / drinks / AW, contaminated water / water containing the pathogen / food washed in contaminated water / contaminated food ; A examples of accidental ingestion e.g. swimming in contaminated rivers A faecal / oral, transmission A bacteria / <i>Vibrio</i> R if described as virus	1
4(d)	A mRNA or messenger RNA <i>any three from:</i> (one strand only needed) to form <u>mRNA</u> / <u>mRNA</u> is single-stranded ; (m)RNA is, used / needed, to produce, <u>subunit</u> (s) / <u>polypeptide</u>(s) ; (only) one strand (of DNA) is the, template / transcribed, strand ; <i>idea that</i> (complementary) copying / transcribing, other DNA strand would not result in, desired / AW, mRNA / polypeptide ;	3
4(e)(i)	<i>any two from:</i> I receptor I active site (mAbs) specific / different, antigen binding sites / binding sites for antigen ; A (each) mAb binds to a, specific / particular, antigen R if antibody described as an enzyme (each mAb has) specific / different, tertiary structure / variable region(s) / primary structure / sequence of amino acids ; binding site and antigen have complementary shapes or ZAC-3 complementary shape to core polysaccharide and lipid A or 2D6 complementary shape to O-polysaccharide ;	2

Answer for Question 31 (9700_s22_23_4)

Question	Answer	Marks
4(e)(ii)	any four from: yes <i>general points</i> (agglutination / motility prevented, so) bacteria less able to, penetrate mucus / attach to intestinal epithelial cells / colonise intestine / AW ; A idea that fewer bacteria able to, attach / colonise intestine less / no, cholera toxin / released ; bacteria passed out in faeces not able to cause disease in others / AW ; ref. to phagocytosis more effective ; e.g. macrophages stimulated to carry out phagocytosis <i>prevention / treatment</i> (to prevent disease) needs to be given, at early stages / before colonising (intestine) ; <u>passive</u> immunity / <u>passive</u> vaccine ; <i>must be in context of treatment or immediate protection</i> <i>idea that</i> in addition to immune response (so increased effect) ; e.g. acts beside, immune system / immune system cells acts before the immune response can become effective ref. to quicker recovery (if a person has cholera) ; useful when, there is antibiotic resistance / antibiotics cannot be given ; <i>specific mAb</i> mAb ZAC-3 may be more effective for cholera caused by, wider range of <i>V. cholerae</i> / AW; mAb ZAC-3 may be useful if exact form of <i>V. cholerae</i> not known ; mAb 2D6, needs to be targeted against specific <i>V. cholerae</i> forms / may not be effective against other <i>V. cholerae</i> forms ; A not all forms of <i>V. cholerae</i> were tested in lab	4

Answer for Question 31 (9700_s22_23_4)

Question	Answer	Marks
4(e)(ii)	AVP ; e.g. (only) short-term protection / not active immunity / not long term ref. difficulty in delivering mAbs to intestine e.g. may be, digested / destroyed, as pass through gut need to find a way to get mAbs to the intestine if given intravenously need to pass through to gut lumen may be able to prevent multiplication of bacteria mAbs have been used successfully for other diseases	

Answer for Question 32 (9700_s22_23_2)

Question	Answer	Marks
2(a)	peptidoglycan / murein ; ribosomes ; (permanent / large) vacuole ;	3
2(b)	<i>any two from:</i> to prevent, lysis / bursting / AW or to prevent, (protoplast) shrinking / shrivelling / AW ; I damaged <i>ref. to</i> no net movement / AW, of water (occurs) ; (otherwise movement of water) by <u>osmosis</u> / down a water potential gradient / AW ;	2

Answer for Question 32 (9700_s22_23_2)

Question	Answer	Marks
2(c)(i)	<i>max 2 if stated as a protein or includes protein features</i> <i>any three from:</i> <i>cellulose molecule max 2</i> (β-glucose(s) joined by) glycosidic / glucosidic, bonds / linkages ; (monomers / β-glucose(s)) joined by (β) 1,4 (glycosidic) bonds ; R α-1,4 bonds R (β)1,4 <u>and</u> 1,6 bonds adjacent, monomers / β-glucoses, rotated through 180° ; AW straight / linear, chain ; <i>cellulose microfibril max 2</i> parallel, molecules / chains, of cellulose ; hydrogen bonds, between molecules / form cross bridges / between OH groups ; <i>idea that between adjacent cellulose molecules,</i> beginnings and ends in different places / overlap between starts and ends / staggered starts and ends ;	3
2(c)(ii)	<i>any one from:</i> hemicellulose ; pectin ; lignin ; AVP ; e.g. expansin	1
2(d)	spongy mesophyll / palisade mesophyll / palisade / mesophyll, (cell) ;	1

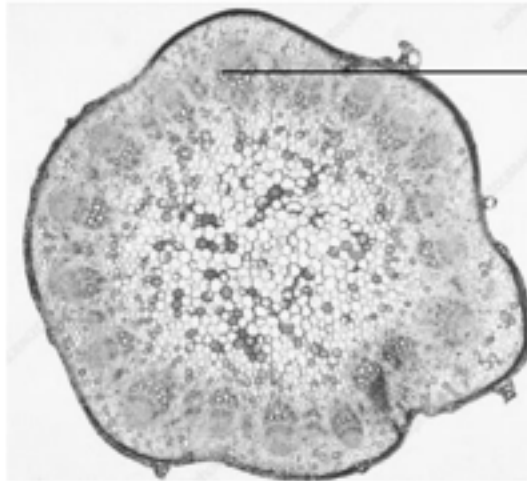
Answer for Question 33 (9700_w22_21_1)

Question	Answer	Marks
1(a)(i)	A mitochondrion ; B <u>rough endoplasmic reticulum</u> ; A ribosome / 80S ribosome	2
1(a)(ii)	any three from: (more efficient) synthesis / metabolism / AW, of named product ; e.g. lipid / named lipid phospholipid steroid / steroid hormone / named, e.g. oestrogen / testosterone sterol / cholesterol I ref. to storage other function ; e.g. detoxification max two from: <i>idea that</i> synthesis of products / AW, is a pathway / requires more than one enzyme ; further detail ; e.g. enzymes of same pathway are, close together / in clusters products of one reaction are substrates of the next <i>suggestion that</i> membrane gives enzymes, more stability / greater protection (from degradation) ; AVP ; e.g. <i>idea of</i> greater efficiency as enzyme held so that active site faces substrates in lumen <i>suggestion that</i> allows reactions to occur on cytoplasmic side of membrane <i>suggestion that</i> allows reaction to continue / complete, in SER transport vesicles	3

Answer for Question 33 (9700_w22_21_1)

Question	Answer	Marks
1(b)	any three from: higher magnification (without loss of detail) ; higher resolution / ability to see object that are close together as separate objects ; ref. to resolution of (up to) 0.5 nm compared to, 200 nm / 0.2 μm (light microscope) ; A ranges, e.g. 0.5–30 nm and 100–300 nm ability to see organelles such as, SER / ribosomes / other named organelle ; AVP ; e.g. very thin sections, qualified, e.g. for greater internal detail	3

Answer for Question 34 (9700_w22_21_5)

Question	Answer	Marks						
5(a)	one mark for named pathways ; one mark for outline of apoplastic pathway ; <table><tr><th>name of pathway</th><th>outline of pathway</th></tr><tr><td>symplast / symplastic</td><td>movement of water from cell to cell via plasmodesmata</td></tr><tr><td>apoplast / apoplastic</td><td>movement of water via, cell walls / intercellular spaces</td></tr></table>	name of pathway	outline of pathway	symplast / symplastic	movement of water from cell to cell via plasmodesmata	apoplast / apoplastic	movement of water via, cell walls / intercellular spaces	2
name of pathway	outline of pathway							
symplast / symplastic	movement of water from cell to cell via plasmodesmata							
apoplast / apoplastic	movement of water via, cell walls / intercellular spaces							
5(b)	label line labelled T to any area of xylem tissue ; e.g. 	1						

Answer for Question 34 (9700_w22_21_5)

Question	Answer	Marks
5(c)(i)	lysosome ;	1
5(c)(i)i	any three from: increased permeability to water ; increased, aquaporins / protein channels (in the tonoplast) ; water potential in vacuole is lower than that of cytoplasm ; A more ions in vacuole lower water potential more water enters (vacuole) by osmosis ; vacuole increases, in volume / pressure (until it bursts) ; AVP ; e.g. fewer transport proteins for exit of ions	3
5(c)(iii)	<i>allow two suggestions or a suggestion with further detail, for two marks</i> active site becomes complementary to substrate ; (because) bonds altered between R groups of amino acids ; A hydrogen / ionic, bonds removal of a portion that blocks the active site ; AW substrate can enter active site ; <i>idea of cofactor / AW, associates with the enzyme ;</i> enzymes becomes functional ; sets off an enzyme cascade / ref. cell signalling ; AVP ;	2

Answer for Question 34 (9700_w22_21_5)

Question	Answer	Marks
5(d)(i)	any two from: caused by a pathogen ; <i>idea that</i> it is transmissible / passed from infected plant to uninfected plant ; results in harm being caused / AW ;	2
5(d)(ii)	protocist ; <u>Plasmodium falciparum</u> / <u>Plasmodium malariae</u> / <u>Plasmodium ovale</u> / <u>Plasmodium vivax</u> ; A <i>Plasmodium knowlesi</i>	2

Answer for Question 35 (9700_w22_22_2)

Question	Answer	Marks
2(a)	S = protein ; A amino acid R protein coat I capsomere T = capsid ; A protein coat R capsomere	2

Question	Answer	Marks
2(b)	170 (nm) ;	1
2(c)	replication / synthesis / AW, of (viral) DNA ; I replication of genes A <i>stated function of DNA polymerase</i> I unwinding of DNA e.g. forms phosphodiester bonds joins / AW, (adjacent DNA) nucleotides R joins complementary nucleotides I joins sugar phosphate backbone	1
2(d)	presence of (viral), envelope / (outer) membrane / phospholipid bilayer ; ref. fluid / flexible ; ref. to preparation (for electron microscopy) ; e.g. distortion / squashed / artefact I ref. to use of the microscope e.g. electron beam affects AVP ; e.g. <i>suggestion of variation in tegument</i> protein, number / arrangement / organisation / AW	2

Answer for Question 35 (9700_w22_22_2)

Question	Answer	Marks
2(e)	<i>similarity, one mark:</i> both have <u>DNA</u> (double stranded, naked / no histones) ; A <u>DNA</u> plus neutral feature e.g. not surrounded by a nuclear envelope I both have genes I components of DNA e.g. deoxyribose / nucleotides / phosphates R both have, single stranded / circular, DNA R both have, DNA free in the cytoplasm / DNA and RNA <i>difference, one mark:</i> bacterial DNA, circular / closed loop (v HCMV linear) I ref. to naked DNA R if comparison for HCMV is incorrect e.g. multilayered or bacteria (can also) have, plasmid DNA / plasmids R if implied that bacterial DNA is <u>only</u> plasmid DNA or bacterial DNA (also) has genes for, metabolism / AW ora or bacterial DNA free in <u>cytoplasm</u> but HCMV DNA surrounded by, capsid / protein coat / T ;	2

Answer for Question 35 (9700_w22_22_2)

Question	Answer	Marks
2(f)	I transcription and translation stops any three from: 1 no, S phase / G₂ phase / mitosis / cytokinesis ; A remains in (G₁) interphase A synthesis phase for S phase I named mitotic stages look for CON e.g. 'no S-phase, so mitosis only has one chromatid' 2 (semi-conservative) DNA, replication / synthesis, does not occur ; A sister / identical, chromatids, do not form R if a phase is stated and it is not given as the S-phase 3 failure to pass checkpoints / does not reach checkpoints ; A ref. to no error checking occurs (<i>in context of checkpoints</i>) I proofreading / error checking, (by DNA polymerase) during DNA replication 4 cell does not, grow / increase in size / increase cytoplasm ; (<i>context of preparing for mitosis / cytokinesis</i>) A grows to normal (non-dividing) size 5 <i>idea that the cell does not, duplicate / synthesise, organelles / extra materials (context is for, cytokinesis / new cells) ;</i> A centrioles do not replicate A microtubules not synthesised R if stated as occurring in S phase (even if e.g. G₂ given as well)	3

Answer for Question 35 (9700_w22_22_2)

Question	Answer	Marks
2(g)	<i>allow virus or pathogen for HCMV</i> <i>look for ora in context of healthy immune system</i> <i>any four from:</i> 1 ref. to time delay in immune response (compared to normal) ; e.g. takes a longer time for, immune system to respond slower (secondary) immune response immune response similar to primary response 2 more time / easier / AW, for HCMV to infect cells / replicate / spread (so cause damage) ; AW R ref. to HCMV as, cells that reproduce / viruses that carry out mitosis <i>impact following primary response and after viral activation</i> 3 few(er), immune system cells / named, (in circulation) ; I fewer white blood cells e.g. fewer, macrophages / neutrophils A phagocytes fewer (B- and T-) memory cells A no memory cells (<i>no longer present from primary response</i>) fewer, (B/T,-) lymphocytes / T-helper cells / T-killer (or cytotoxic) cells <i>context for lymphocytes could be reduced number circulating at time of viral activation or owing to poor secondary response(compared to normal)</i> fewer / no, plasma cells 4,5 consequence of fewer immune system cells ;; <i>two marks</i> e.g. less chance of / AW, encounter with / recognition of / activation by, (non-self / foreign) antigen / HCMV / virus / pathogen / infected cell (fewer memory cells) ref. reduced clonal expansion / AW (so fewer lymphocytes / plasma cells)	4

Answer for Question 35 (9700_w22_22_2)

Question	Answer	Marks
2(g)	(fewer plasma cells) lower concentration of antibodies A no antibodies (as no plasma cells) A longer time for antibody, production / concentration to build up (fewer T-helper cells) less cytokine released A effect of cytokine <i>if spelling of cytokine</i> rejected (fewer T-killer cells) fewer infected cells killed / A perforin / granzymes / hydrogen peroxide, not released (fewer phagocytes) less phagocytosis for antigen presentation	

Answer for Question 36 (9700_w22_23_1)

Question	Answer	Marks
1(a)(i)	C-N bond shown ; =O shown on C and -H shown on N of peptide group ; water shown as a product ;	3
1(a)(ii)	peptide ; A amide R polypeptide bond	1
1(a)(iii)	ribosome ; I 70S / 80S A <u>rough endoplasmic reticulum</u> I rough ER / RER	1
1(b)(i)	<i>any two from:</i> alpha- / α -, helix, helices ; R A or a <i>for alpha</i> beta- / β -, pleated sheet(s) / pleat(s) ; A beta / β , sheet(s) R B or b <i>for beta</i> region of no fixed shape / AW ; A random coil	2

Answer for Question 36 (9700_w22_23_1)

Question	Answer	Marks
1(b)(ii)	<i>any two from:</i> 1 protein is, a single <u>polypeptide</u> / made of one chain of amino acids or quaternary structure is two or more <u>polypeptides</u> / more than one <u>polypeptide</u> ; 2 interactions / bonds, between, R-groups / side chains, (of amino acids) on the same <u>polypeptide</u> or 3 quaternary has, interactions / bonds, between, R-groups / side chains, (of amino acids) on <u>different polypeptides</u> ; 4 AVP ; e.g. no prosthetic group	2
1(b)(iii)	<i>secondary structure</i> 1 in alpha-helix each N-H forms hydrogen bond with C=O three or four amino acids apart in same polypeptide ; 2 in beta-pleated sheet each N-H forms hydrogen bond with C=O on adjacent part of the polypeptide ; <i>if mp1 or mp2 not awarded</i> 3 (by) hydrogen bonds (in secondary structure) ; <i>tertiary structure</i> 4 hydrogen bonds between, R-groups with C=O and HN groups / carboxyl and amine groups ; A between polar R groups 5 ionic bonds between R-groups with NH_3^+ and COO^- groups ; A between charged R groups / AW 6 hydrophobic interactions between non-polar R-groups ; <i>if mp4, mp5 or mp6 not awarded</i> 7 (named) interactions / bonds, between R-groups (in tertiary structure) ;	3

Answer for Question 37 (9700_m21_22_1)

Question	Answer	Marks
1(a)	X = mucous gland ; Y = cartilage ; A chondrocytes	2
1(b)	(fibrous / structural) protein ;	1
1(c)	alveolus 'no' <u>and</u> all other boxes 'yes' ;	1

Answer for Question 38 (9700_m21_22_3)

Question	Answer	Marks
3(a)	<i>any one from:</i> stimulate / enhance / AW, macrophage response ; stimulate / enhance / AW, B-lymphocyte / B-cell / humoral, response ; A described part of humoral response e.g. increase antibody production stimulate / enhance / AW, T-killer / T-cytotoxic, response ; AVP ; e.g. suppresses immune response (during recovery) role in inflammation ref chemotaxis	1
3(b)(i)	<i>any two from:</i> <i>Leydig cell / not T-helper lymphocyte, because:</i> much / many / high proportion of, smooth endoplasmic reticulum ; (smooth endoplasmic reticulum present) that functions to synthesise, cholesterol / testosterone / steroid hormones / lipids ; no / little, rough endoplasmic reticulum ; rough endoplasmic reticulum is for polypeptide / protein synthesis ;	2
3(b)(ii)	transmission electron micrograph ; <i>plus one from:</i> cell ultrastructure can be seen / high resolution ; A detail e.g. membranes of mitochondrion cristae nuclear, envelope / membranes endoplasmic reticulum I rough / smooth (very) thin section / not surface contours / AW ; I ref. to magnification	2

Answer for Question 38 (9700_m21_22_3)

Question	Answer	Marks
3(c)(i)	<i>one correct mechanism stated plus one associated detail</i> (passive / simple) diffusion ; R facilitated diffusion / diffusion through (membrane) protein from high(er) to low(er) concentration / down a concentration gradient ; AVP ; e.g. via phospholipid bilayer / hydrophobic core / fatty acid tails / AW or endocytosis ; description / pinching in / vesicle formation ; AVP ; e.g. ATP / energy, required	2
3(c)(ii)	<i>any two from</i> hydrophilic / water soluble / polar ; cannot cross, hydrophobic core (of phospholipid bilayer) / AW ; too large (to pass through gaps in fatty acid tails) ; no (specific), transport / carrier, proteins ;	2

Answer for Question 39 (9700_m21_22_4)

Question	Answer	Marks
4(a)(i)	C = red blood cell / erythrocyte A red blood corpuscle D = lymphocyte A plasma cell R if also stated as granulocyte A B- or T-Cell I white blood cell / leucocyte / agranulocyte E = monocyte R if also stated as granulocyte I white blood cell / leucocyte / agranulocyte A macrophage F = neutrophil A eosinophil A basophil R if also stated as agranulocyte I white blood cell / leucocyte / granulocyte C correct = one mark D correct = one mark E and F correct = one mark	3
4(a)(ii)	<i>any two from:</i> <i>more white blood cells because</i> <i>result of immune response ;</i> <i>clonal expansion / described, of, B- / T-, lymphocytes / cells ;</i> <i>idea of producing (large quantity of specific) antibody in context of immune response</i> <i>increased, production of macrophages / phagocytes ;</i> <i>if written in context of HIV/AIDS as the infectious disease</i> <i>fewer white blood cells ;</i> <i>further detail ; e.g. T-helper lymphocytes destroyed</i>	2

Answer for Question 39 (9700_m21_22_4)

Question	Answer	Marks
4(b)	1 decreased / 13% less, percentage oxygen saturation / percentage saturation haemoglobin with oxygen <u>and</u> similar (quantity) / same (quantity) / 0.1 cm³ per 100 cm³ blood less, oxygen delivered by haemoglobin to tissues ; <i>plus any three from:</i> 2 at high altitude lower partial pressure of oxygen, in atmosphere / in inhaled air / in alveolus / into pulmonary capillaries / AW ; 3 in lungs / in pulmonary capillaries / at the alveolus, less oxygen, binds to / taken up by / AW, haemoglobin ; 4 haemoglobin has lower affinity for oxygen (in lungs) ; 5 increased production of haemoglobin ; 6 increased, production / number / density, of red blood cells ; A increased haematocrit 7 (so) more haemoglobin available to bind oxygen / same quantity of oxygen can be taken up as at sea level ; 8 AVP ; e.g. ref. to decreased plasma volume increase in erythropoietin (EPO) concentration other described physiological change	4
4(c)	absence of, good health / well-being / lack of <u>physical</u> well-being / AW ; A disorder / illness further detail ; e.g. having an adverse effect reduced / impaired, function A described e.g. less oxygen, taken up / transported produces, (specific) signs / symptoms ; A described symptoms	2

Answer for Question 40 (9700_s21_23_6)

Question	Answer	Marks
6(a)	correct working ; e.g. $14\,000\,000 \div 1400$ (A–B = 13 to 15 mm) (x) 9286 / 9642 / 10 000 / 10 357 / 10 714 ; <i>incorrect conversions used in working or incorrect measured value of A–B can be awarded the answer mark as ecf – the working must show use of dividing by 1400 (or incorrect conversions of 1400)</i>	2
6(b)	any four from two chromatids drawn with, non-metacentric centromere / chromosome arms unequal length ; (sister) chromatid ; centromere ; <i>allow as a constriction</i> telomere ; <i>must be labelled at / towards the end</i> AVP ; e.g. four telomeres labelled or telomere sectioned off at each chromatid end and one labelled DNA and histones gene / allele <i>must be shown as a section</i>	4
6(c)	R homologous chromosomes any one from most condensed state ; AW I chromosomes, are condensing / condense chromosomes (all) in one, plane / focus ; A <i>idea of all at the equator (so clearly visible)</i> I line up. horizontally / vertically	1
6(d)	anaphase ;	1

Answer for Question 41 (9700_s21_23_1)

Question	Answer	Marks
1(a)	<i>structure max 2 marks</i> 1 RER has ribosomes R if context is within lumen or SER does not have ribosomes ; 2 RER, flattened sacs / cisternae, <u>and</u> SER tubular ; AW 3 RER continuous with, (external) nuclear membrane ; ora I near to nuclear membrane R continuous with <u>internal</u> nuclear membrane 4 <i>ref. to</i> RER, more regular / layered, arrangement or SER more irregular / disorganised, arrangement ; <i>function</i> 5 RER produces / transports, proteins / glycoproteins ; A polypeptides A examples of post-translational modification 6 SER produces, lipids / cholesterol / steroids ; A stores I produces hormones	3
1(b)	<i>any two from</i> <i>ref. to</i> phosphate (group) and two fatty acid, chains / tails / residues ; A two hydrocarbon chains correct <i>ref. to</i> attachment, phosphate / fatty acids, to glycerol ; AVP ; e.g. <i>ref. to</i> ester bond <i>ref. to</i> additional group e.g. choline-containing <i>ref. to</i>, saturated / unsaturated, (fatty acid tails) <i>award marks from an annotated diagram</i>	2

Answer for Question 41 (9700_s21_23_1)

Question	Answer	Marks
1(c)(i)	flattened sacs / cisternae ; stack / layered / described ; <i>any one from</i> <i>idea that</i> each cisterna in stack is, separate / not interconnected ; smooth (outer surface) / no ribosomes ; close to, nucleus / RER ; single membrane ; AVP ; e.g. two distinct faces <i>ref. to</i> swollen ends to cisternae	2
1(c)(ii)	<i>ignore events occurring before vesicle formation</i> <i>any three from</i> vesicle moves to, cell surface / cell (surface) membrane ; A plasma membrane movement of vesicle via, cytoskeleton / microtubules ; vesicle fuses with (cell surface) <u>membrane</u> (and protein released) ; AW e.g. vesicle makes contact with <u>membrane</u> and becomes part of it I attaches to / binds to exocytosis ; I bulk transport / excreted / secreted <i>allow in context of release only or movement from Golgi and release</i>	3
1(c)(iii)	<i>any one relevant e.g.</i> acts as (self-)antigen / recognition site / cellular recognition / receptor / membrane stability / cell adhesion ; I involved in cell signalling	1

Answer for Question 42 (9700_s21_23_5)

Question	Answer	Marks
5(a)	<i>allow one mark if monocyte <u>and</u> neutrophil both labelled as phagocytes and no other cell is labelled phagocyte</i> <i>allow phagocyte for either the monocyte or neutrophil if the other cell correct</i>  red blood cell / erythrocyte ;  monocyte / macrophage; white blood cell leucocyte  neutrophil ; A polymorphonuclear leucocyte / basophil / eosinophil  lymphocyte ; B / T B-cell / T-cell	4
5(b)	15 / 15.0 / 15.1 / 15.2 (kPa) ; 0.09 / 0.10 / 0.1 (s) ;	2

Answer for Question 42 (9700_s21_23_5)

Question	Answer	Marks
5(c)(i)	<i>emphysema and chronic bronchitis do not need to be named</i> <i>any one from must be in context of COPD</i> less, air / oxygen, able to reach, alveoli / air sacs / gas exchange surface ; less <u>oxygen</u> able to, diffuse to / AW, capillaries (from, alveoli / air sacs) ; ventilation impaired / AW ; <i>any two from effects of chronic bronchitis and emphysema</i> inflammation (of respiratory airways) ; build up / accumulation / excess / AW, of mucus decreased lumen of, trachea / bronchus / bronchioles / respiratory tubes / airways ; A airway obstruction I blocked A constriction / narrowing (loss of, elastin / elastic fibres, so) less ability (of alveoli) to recoil ; alveoli, burst / destroyed or alveolar walls break down ; large(r) air sacs (instead of alveoli) / AW ; decreased / reduced, SA:V ; <i>of, alveolar area / gas exchange surface area</i> AVP ; e.g. relevant effect of pulmonary hypertension affecting gas exchange	3
5(c)(ii)	<i>any two from</i> decreases quantity of, <u>oxygen</u> / O₂, taken into blood / absorbed / transported (back to heart) ; AW A fewer red blood cells to take up <u>oxygen</u> A blood less oxygenated decreases quantity of, <u>carbon dioxide</u> / CO₂, leaving blood / excreted / AW ; A more carbon dioxide remains in the blood (than normal) increased, ventilation / breathing, rate ; R breathes more deeply AVP ; e.g. further increase in pulmonary hypertension	2